The world's best guide book to the enjoyment of music

Entertaining
Instructive
Convenient

Are you familiar with the story of the opera of Rigoletto? Of Faust? Of Pagliacci?

Do you know the national airs of Denmark and China?

Do you know which Kipling ballads have been set to music?

Did you know that Chopin was pronounced a genius at eight years of age?

Information on all these subjects is to be found within the **510** pages of the Victor Record catalog. It presents in alphabetical order, cross indexed, the thousands of Victor Records which comprise the greatest library of music in all the world. But besides that it abounds with interesting musical knowledge which adds greatly to your enjoyment of all music. It is a book every music-lover will want, and there is a copy for you at your Victor dealer's. Or write to us and we will gladly mail a copy to you.

"HIS MASTER'S VOICE"
REG. U.S. PAT. OFF.

This trademark and the trademarked word "Victrola" identify all our products. Look under the lid! Look on the label!

VICTOR TALKING MACHINE CO.
Camden, N. J.

Victor Talking Machine Company, Camden, N.J.

"THE WOOD THAT ALL ITS USERS PRIZE
THE WISE INVESTOR SAFELY BUYS."

A WORD

as to the

Reasons and Purposes

behind the

Cypress Pocket Library

Everybody likes to build, but nobody likes "repair jobs."

Repair jobs inevitably represent *an additional investment without any addition to value.*

That point is worth digesting.

When you build, whatever you build, you like to build "for keeps."

Some people change their minds about styles, in building the same as in wearables; our tastes develop and result in changes in our wants; but nobody changes his or her mind as to wishing to get the greatest possible *endurance*, or *wear*, out of the things they buy, and especially is this true of *building* investments.

Yet, singularly enough, so many people know so little about *woods* and their relative values and special utilities; so many people think that "lumber is lumber" and never attempt to *specify* the *KIND* of wood they wish used; so many people believe that repair bills are "necessary evils," that we believe we shall be able to render a real public service by continuing the publication of THE CYPRESS POCKET LIBRARY, convenient in size, authoritative in character, of *probable* value as a technical guide, and careful and scrupulous in its every statement or inference.

We have not, and do not, by any means, recommend the use of Cypress without discrimination; Cypress is not the best wood for *every* use; but where it IS appropriate it is so *emphatically* (and demonstrably) the *one best wood* that the *many* should know about it instead of the comparatively few who formerly profited by their special knowledge.

WRITE FOR VOLUME I, with full text of U. S. Government Report on Cypress, and containing complete list of all the 43 volumes in the library. Then write us for the volumes that will best serve you.

It may be of interest that many of the volumes of The Cypress Pocket Library have become established as standard works of reference—text books—in a number of eminent educational institutions and Government Departments. This is a gratifying tribute to the broad and helpful spirit in which these booklets have been produced, and more than justifies the theories behind the original *pioneer* idea of such a Library for Lumber USERS.

Let our "ALL-ROUND HELPS DEPARTMENT" help YOU. Our entire resources are at your service with Reliable Counsel

SOUTHERN CYPRESS MANUFACTURERS' ASSOCIATION

1249 Perdido Building, New Orleans, Louisiana,
or 1249 Heard National Bank Building, Jacksonville, Florida

INSIST ON **TRADE-MARKED** CYPRESS AT YOUR LOCAL LUMBER DEALER'S
IF HE HASN'T IT, *LET US KNOW IMMEDIATELY*

Popular Science Monthly

JAN., 1921
Volume 98-No. 1

Important to Readers

Owing to the paper shortage, the number of printed copies of POPULAR SCIENCE MONTHLY is limited. To insure getting your magazine regularly, you should place a standing order with your newsdealer, or send us your yearly subscription of $3.00. Don't miss the big Holiday Offer on page 13.

CONTENTS

AERONAUTICS

At Last—the Fireproof Airplane 24
The Typical Airplane Motor 29
A Free Balloon that Hasn't Any Net 52
Save the Mail from Fire 55
Is it Good Flying Weather? 56

FOR THE FARMER

Bossy's Wearing Stockings Now 35
Grubbing Up Tree-Stumps with Liquid Oxygen, ... 48
A One-Man Ice-Cutting Machine 53
A Machine to Compress Silage 56
Fodder Made of Sawdust 70

HOUSEKEEPING MADE EASY

Make Your Own Ice 34
Squeezing Out the Last Drop 36
A Three-Inch Cedar Chest 38
Anchor Cuff-Links to the Shirt 38
Measuring the Home-Brew Kick 46
Getting Rid of the Japanese Beetle 49
How to Strengthen Flower-Pots 52
Thawing Pipes by Torch 52
Family Portraits on a Rod 53
Reading the Temperature 53
Clean Your Shoes on a Skate 54
A Hot-Water Bottle for Teeth 54
A Bird-Cage Hanger Clamps to Molding 55
A Place for Rubbers 57
The Handy Little Magnet 57
This Plug Will Fit Any Socket 70
This Brush Reaches All the Teeth 70
Frames from Automobile Lenses 71
A Gear-Shift-Lever Poker 73
Sharpening Phonograph Needles 74

INDUSTRIAL PROGRESS

What We Pay for Idle Machines 23
Reducing the Handling Cost 25
Safety for Elevator Passengers 26
Trimming Brushes by Machine 32
A Thousand-Ton Concrete Ship 33

(Continued on page 4)

Copyright, 1920, by the Modern Publishing Company

POPULAR SCIENCE MONTHLY is issued monthly. Yearly subscription in the United States, $3.00. Canada, $3.50. Foreign, $4.00. Single copy, 25 cents.

Advertising rates on application. Forms close the twentieth of the second month preceding date of publication. Entered as second-class matter Dec. 28, 1915, at the Post Office at New York under the act of March 3, 1879. Entered as second-class matter at the Post Office Department, Canada.

The contents of this magazine are copyrighted and must not be reprinted without permission. H. J. Fisher, President; R. C. Wilson, Vice-President; O. B. Capen, Secretary and Treasurer.

Modern Publishing Company
225 West Thirty-ninth St. New York City

T505
v.98-99

Popular Science Monthly

Waldemar Kaempffert, *Editor*

January, 1921; Vol. 98, No. 1
25 Cents a Copy; $3 a Year

Published in New York City at
225 West Thirty-ninth Street

Telegraphing the Picture of an Escaping Criminal

Monsieur Bélin's remarkable invention will also take its place in the professional and business world

By A. J. Lorraine

He Is the Inventor of the Telephotograph

Monsieur Edouard Bélin, the inventor of the process and apparatus described in these pages, is also known to the scientific world as the man who designed and installed a system of radio signals sent out hourly to all the world from the Eiffel Tower.

He is now working on the problem of television, and is optimistic that you may, within this generation, be able to see (literally speaking) your friend over the wire, as you now converse with him by telephone.

A BLOOD-CURDLING shriek has been heard in the dead of the night, seemingly coming from a ramshackle hut long since abandoned. Then silence over all. The neighbors, either too sleepy or too scared to investigate, presently fall back on their pillows, to be awakened again only by the light of day.

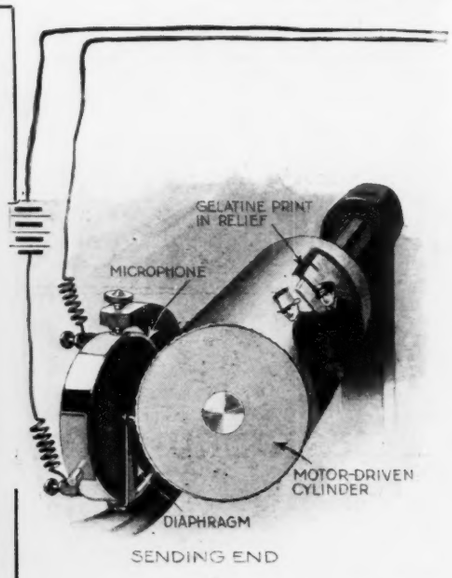
But with the morning a group of men and women, after gossiping for a while over the occurrence, approaches the hut with mingled curiosity and dread. From the distance the entrance is hidden by thickly grown bushes that have had their way for many years, untouched by the hand of man. As the search-party draws near, however, they look with horror on the frightfully mutilated body of a woman lying across the doorstep.

The police are called. It quickly develops that circumstantial evidence points strongly to a man recently seen prowling about the neighborhood. He is a man with an "established reputation" who is listed and figured in the rogues' gallery. A photograph of him is procured from the gallery.

In forty-eight hours he may be any-

Monsieur Bélin, who recently made a visit to the United States at the invitation of the New York *World*, to conduct experiments in the electric transmission of photographs

The victim of a gem robbery in Pittsburgh identifying the rogues' gallery photograph of "Slick Jack" as the likeness of her discharged butler



A chrome-gelatine print of the photograph is curled around the cylinder, which is rotated past a tracing-point. At the same time the cylinder moves lengthwise along the axis, so that the tracing-point follows a spiral course. As the tracing-point moves over the crests and furrows of the photograph, the diaphragm of a microphone attachment is vibrated so that the current in the telephone circuit varies in the same way as when one speaks over the wire

where within a two thousand miles radius from the scene of the crime. Of what avail is a photograph of him in New York if he should seek a hiding-place in Chicago? True, photographs can be mailed, but immediate action is wanted.

In this, as in so many emergencies, modern science has resources to cope with the situation. Edouard Bélin, the noted French physicist, has recently come to this country to conduct experiments on the electric transmission of photographs. This art, which even now has to its credit no small measure of success, undoubtedly has a great future before it.

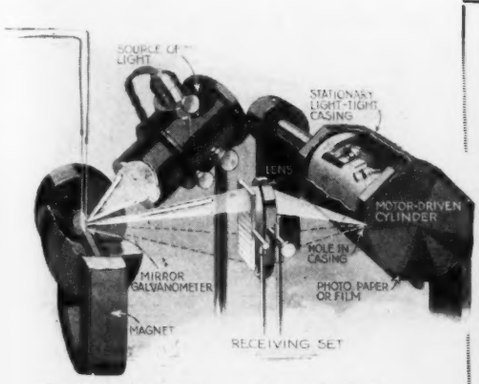
The Beginnings of Telephotography

It is interesting to note the very earliest efforts in the transmission of pictorial information by telegraph. In 1879 a Frenchman named Gras conceived the idea of transmitting, for military purposes, for example, a topographic map or picture. He divided the chart into a checkerboard of squares, like a chessboard, and assigned numbers to each horizontal row of squares, and letters to each vertical column, in much the same way that chess-players designate the position of chessmen. He could then telegraph his chart, roughly, in such a code as this: River Y2 to B2, B2 to B13, B13 to T13. Bridge B8. Highroad A8 to M8, split to W2 and V13.

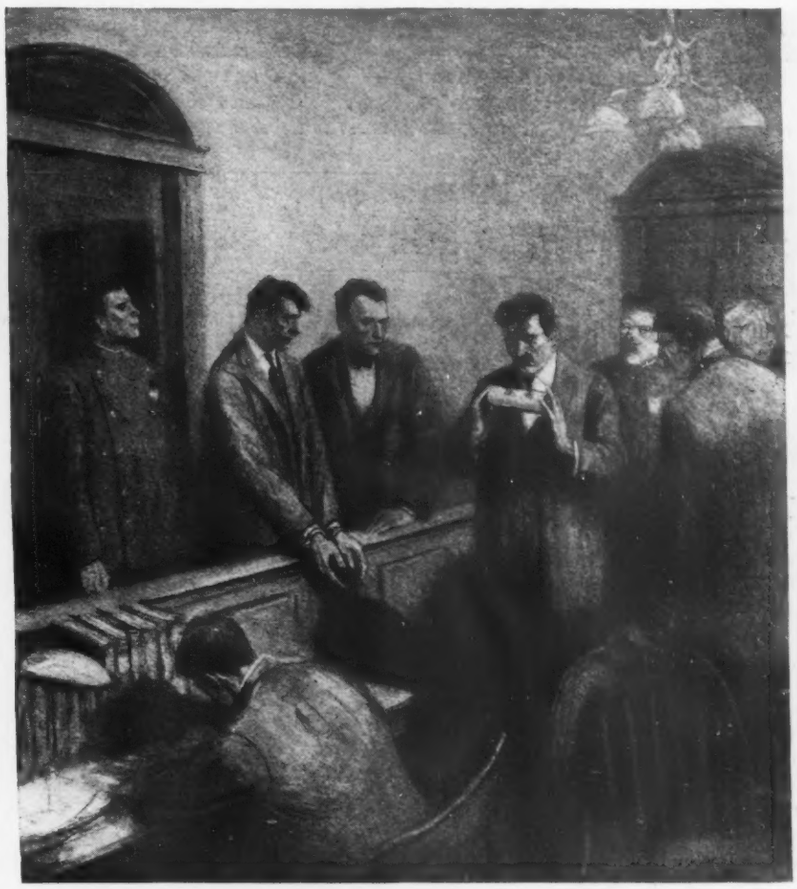
Since this first and primitive suggestion, a considerable number of more or less successful efforts have been made in the transmission of photographs by electricity. Some inventors have made use of the property that the element selenium possesses of changing its electrical resistance with the intensity of the light falling upon it. Such "selenium cells," however, are delicate, and the effect of light on them is not instantaneous, but requires a certain time to assert itself; the changes in the resistance of the cell lag behind the corresponding light changes. It is true that in the most successful developments of this method (especially as carried out by Professor Korn of Berlin), these difficulties seem to have been very satisfactorily met. Nevertheless, a method that entirely avoids the use of light-sensitive apparatus at the transmitting end is very inviting to any one who knows the difficulties of working with selenium cells.

It seems at first sight almost illogical to attempt to transmit a photograph—a thing whose very appreciation by the senses depends on light—without making use of any light-sensitive transmitter. As well might you try to recognize the photograph of your friend in a perfectly dark room. Exactly: that is just the point.

Suppose you handed your photograph to a blind man. Presumably he would proceed to investigate it by



The "ear" that hears the telephotograph at the other end of the wire is a delicate galvanometer, a loop of wire supporting a tiny mirror stretched between the poles of a magnet. When the current from the microphone varies, the mirror turns through a slight angle, reflecting a powerful beam of electric light through a graduated screen on to a photographic film revolving on a cylinder at the same rate of speed as the sender cylinder



"Slick Jack" confronted by his own photograph, which was telegraphed from Pittsburgh to Portland, Maine, and which arrived before he did, facilitating his arrest

running his finger-tips over its surface. Of course he would be unable to form any conception of its appearance.

And yet, by means of a delicate instrument, a photograph, suitably prepared, can be read "by touch." This is what Bélin has achieved.

The amateur photographer may have observed that some negatives display a distinct relief effect. It seems that certain conditions of development or of fixing produce this appearance, which ordinarily is a mere curiosity of no practical significance. Advantage has, however, been taken of this phenomenon in the rotogravure printing process. A print is made on a gelatine surface impregnated with bichromate. This substance has the property of becoming insoluble on exposure to light. Development of the exposed print consists simply in washing out the unaffected soluble gelatine, leaving the insoluble part behind. It is not surprising that the picture so produced should be found to display a more or less marked plastic or relief effect. By the use of especially heavy gelatine coatings this feature may be emphasized as desired, and the rotogravure process—by which, for example, the picture pages of some of our Sunday newspapers are prepared—makes use of such relief photographic prints somewhat as the older half-tone and similar printing processes made use of etched metal plates.

It is a chrome-gelatine print of this kind that Monsieur Bélin uses in transmitting photographs by electricity. The original to be transmitted is curled around a cylinder like the cylinder of a phonograph. A tracing-point is applied to the surface of the photograph, which is then rotated at constant speed past this point. At the same time, the cylinder moves lengthwise along its axis, so that the tracing-point follows a spiral course upon the curled photograph, and covers every point on its surface. In this way it literally "feels out" the photograph.

But if the instrument kept its knowledge to itself, so to speak, it would be of no use to us. There must be means of translating into visible signs the indications that the blind instrument has read by touch. Furthermore, they are to be transmitted some distance.

A desperate encounter between a gang of desperadoes and the police. This particular gang first stole an automobile and then robbed a bank

Listening to a Photograph

Both these ends are secured at one stroke, in this apparatus, by the aid of a microphone. What has a microphone, that is to say a telephone transmitter, to do with the despatch of a photograph? Well, after going through the seemingly crazy performance of examining a photograph by the sense of touch, why stop at that? Why not listen to a photograph with your ear? In a sense, that is what Monsieur Bélin's apparatus does. It translates the currents coursing in a telephone circuit, which we ordinarily translate by listening with the ear. These currents are translated into a visible likeness of the photograph at the transmitting end.

And this is how the thing is done:

The tracing-needle, whose (rounded) point bears against the relief photograph, is applied, at its opposite end, against the diaphragm of a microphone receiver. And so, as the tracing-point moves in and out among the crests and furrows of the photograph, the resistance of the microphone fluctuates, and the current in the telephone circuit varies in the same way as when you are conversing over the wire. Only, the language it speaks no man ever heard of. It now needs to be translated into a photograph at the receiving end. Naturally, the translator needs, first of all, an ear to hear the message.

The Receiving Apparatus

This ear is a delicate galvanometer, a loop of wire stretched between the poles of a magnet. When the current from the microphone varies, the loop of wire is caused to turn through a slight angle. On the loop is fixed a very small mirror, which receives a beam of light from a brilliant electric lamp.

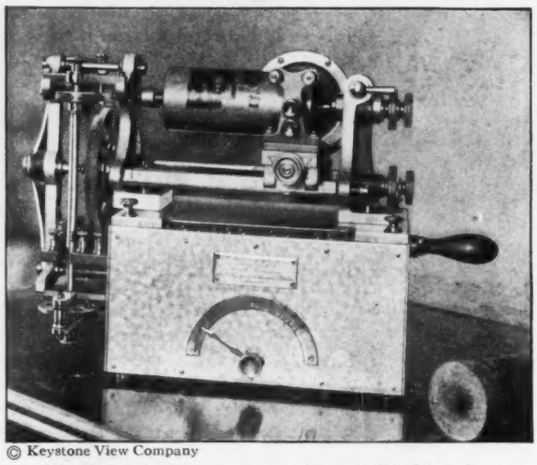
As the mirror turns, the reflected beam also turns. It passes through a screen and then through a lens that focuses the beam on a small aperture in the wall of a light-tight cabinet or case. In this case revolves a second cylinder precisely like the one in the transmitting apparatus on which the photograph to be transmitted is wound. On this second cylinder is curled a piece of sensitized photographic film.

The mechanism of the second cylinder is arranged to keep exact time with that of the first.

Monsieur Bélin has devised a very ingenious contrivance to secure this result. A cam on the carriage of the despatching cylinder trips a lever once in each revolution. At the receiving end a ratchet corresponding to this cam is caught by a pawl, and the movement of the receiving cylinder is thus arrested until the cam at the despatching end is exactly in the position corresponding to that of the ratchet at the receiving end. Then the pawl releases the receiving cylinder, which now proceeds on its revolution. Needless to say, the adjustment is so made that the period of arrest is only a minute fraction of a second.

Now this is what happens: When the tracing-point which "feels" the photograph is at a high point in the relief, the microphone resistance is lessened by the pressure, and a stronger current flows through the galvanometer; the beam of light is deflected toward the left, say. This does not affect its ultimate arrival at the opening in the casing, since all rays from the course are converged to the same focus. But interposed in the path of the beam is a graded screen, fully transparent at the right-hand end, and shading off gradually to complete capacity at the left-hand end. Hence the ray received when the tracing-point is on a high spot of the photograph (*i. e.*, a dark spot); the light is almost completely cut off before it reaches the sensitized film in the dark cabinet. On the contrary, when the tracing-point is feeling out a hollow in the photograph (*i. e.*, a light spot), then the galvanometer receives little or no current, the beam of light passes through the transparent part of the screen, and a maximum of light is received at the film. In this way a negative copy of the original is produced.

The reproduction of a photograph in Monsieur Bélin's collection that was actually transmitted by telegraph. It does not differ in appearance from an ordinary photograph. This invention may soon be used for sending telegrams; the message could be written in heavy ink and transmitted in the same manner as the photographs



© Keystone View Company

The simple looking apparatus invented by Monsieur Bélin for telegraphing photographs. He is now working on an invention that he believes will enable a person at one end of a wire to see the person with whom he is talking

Thus the net is drawn closer than ever by Monsieur Bélin about the fugitive from justice. The crime of the abandoned hut will not go unpunished. While the murderer is speeding in the express to a place of greater safety from pursuit, his photograph is being traced point by point, with the unerring finger of the Bélin transmitter. Not many minutes later the police departments of all the principal cities of the land are in possession of the portrait. As the culprit steps from the train, he is met by an officer and plain-clothes men holding his photograph in their hands. His likeness has traveled ahead of him, and has beaten him in the race by several hours!

Telegraph Your Handwriting

Aside from its application to police service and to the rapid transmission of pictorial news items for the daily papers, Bélin's invention may also be used for the despatch of ordinary telegrams. The message is simply written out with a somewhat heavy ink, and is then transmitted just like a photograph. Thus the services of a skilled Morse operator can be dispensed with. Moreover, since your very own handwriting goes forward over the wire, you may sign in New York a check to be cashed by the consignee in San Francisco!

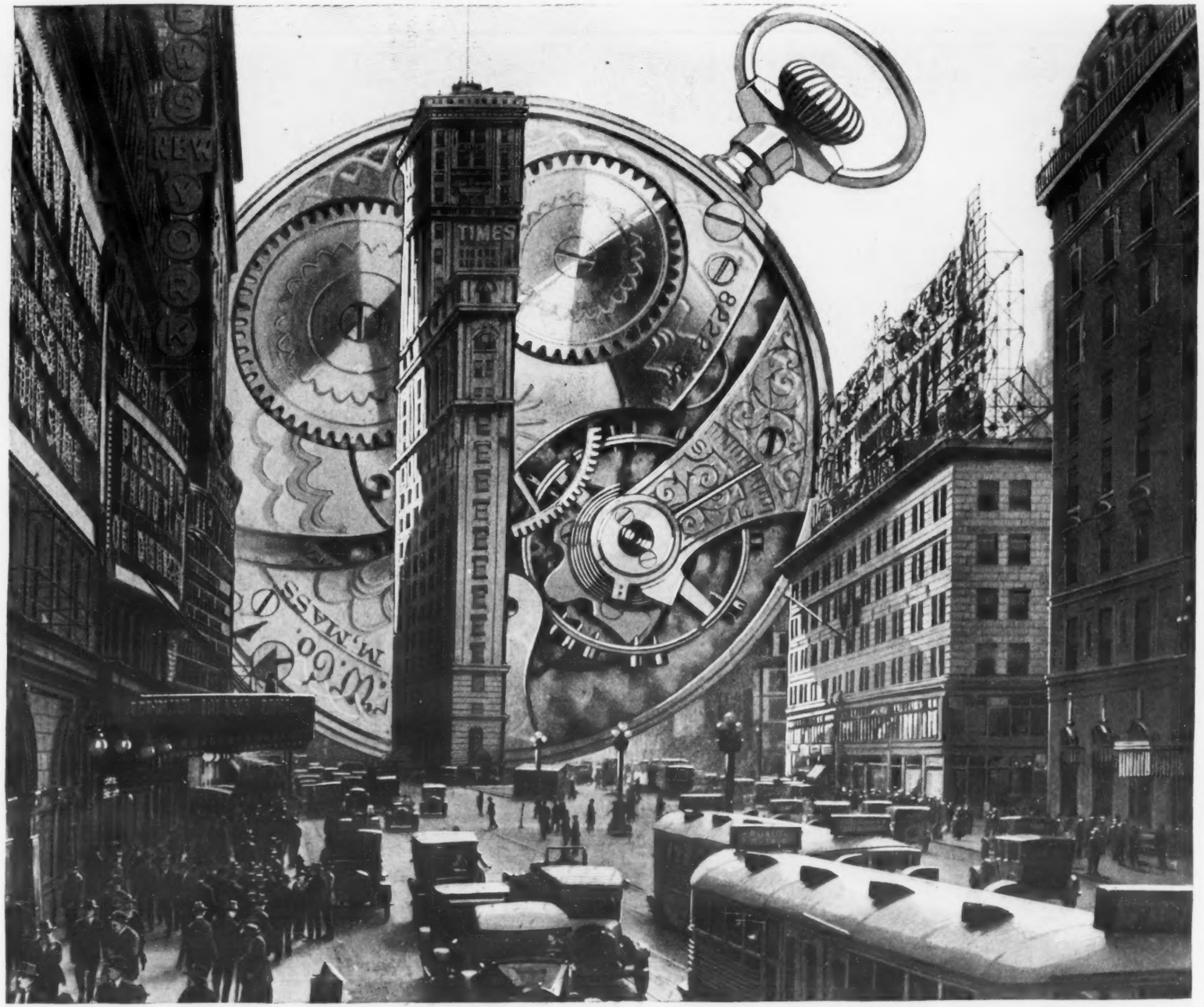
The busy financier need not waste his precious moments going out of his way to sign that million-dollar contract that has been under consideration for months past. He can complete the transaction at his desk, setting his hand and seal to the document by telephone.

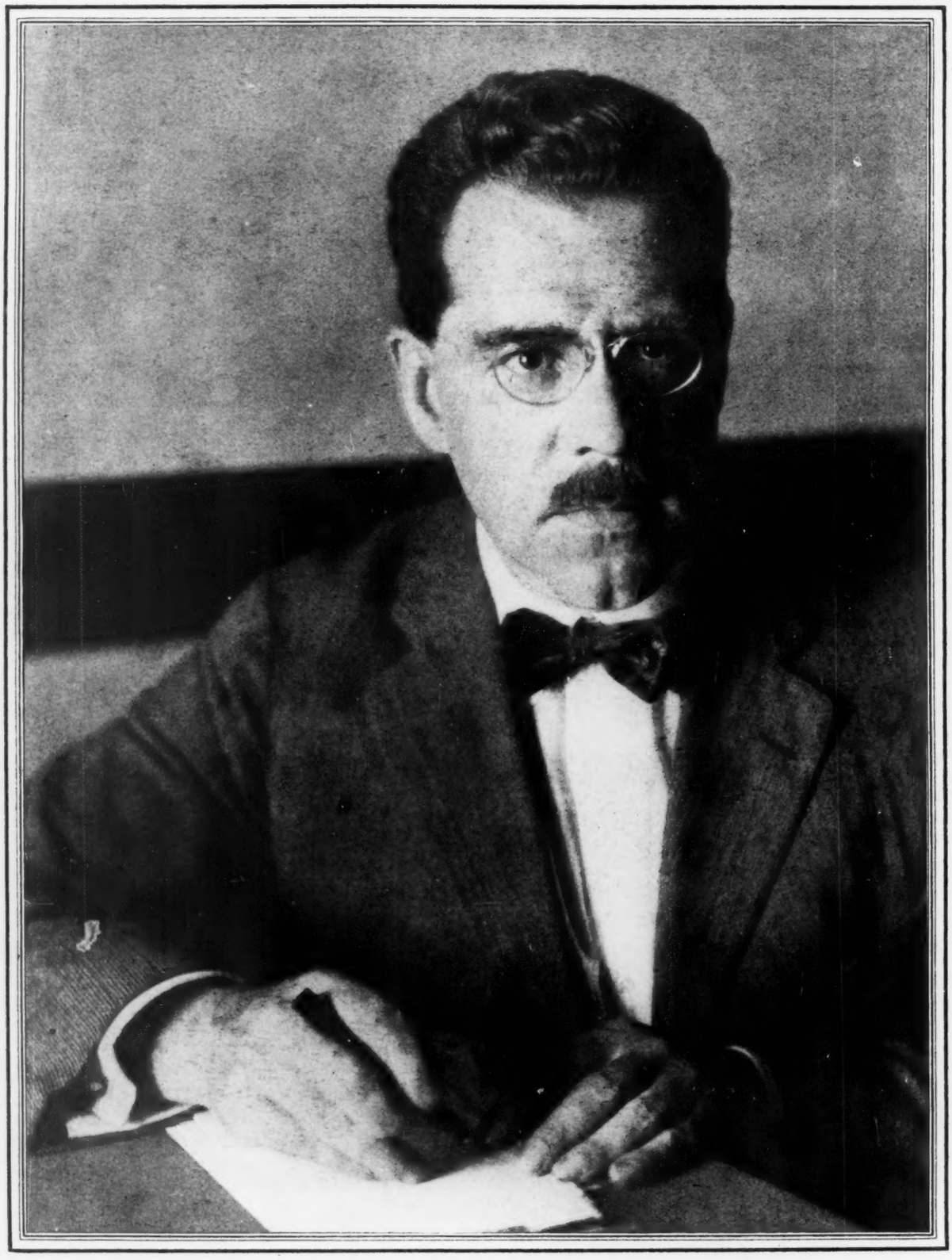
If a Watch Were as Big as the Times Square Tower

DID you ever stop to think what a fine piece of mechanism your watch is? A good watch will keep time to within one or two seconds a day. Yet the power that drives it is amazingly small.

Supposing that every man, woman, and child in New York city were provided with a watch, all these time-keepers made into one would tower about as high as the Times Square Building. Yet about one horsepower would suffice to drive this huge watch.

It would take three gangs of seven men each, working in eight-hour shifts, to keep the monster watch going





Walter N. Polakov, Student of Industrial Relations

"About twenty years ago," says Walter N. Polakov, who has been retained as consulting engineer by the Board of Estimate of New York city, "I was assistant superintendent in a locomotive plant in Russia. A strike was threatened. I was selected by the management to be one of a committee to adjust the differences between the men and the company. One evening, on invitation, I attended a meeting of the men, and there I met an old man called 'Uncle John.'

" 'Young man,' said he, 'how can you adjust our differences until you have investigated the conditions under which we work? Now take my advice and, before you do anything, take a watch and time the work of each man. See how long each workman has to wait for the rivets he must drive, how long it takes to sharpen his tools. We don't want to be idle, for every minute we lose waiting for work deducts from our pay.'

"Uncle John was right. The men did not want to go on strike. They merely wanted conditions made possible for efficiency. That was my start in adjusting the human element to the mechanical element in industrial plants."

What We Pay for Idle Machines

Walter N. Polakov points a possible solution of the problem

By David Ardsley

HERE is a two-family house, each family paying to the landlord fifty dollars rent a month. One family moves away, and the landlord demands one hundred dollars rent from the remaining tenant.

"But it isn't worth it!" says the tenant.

"You've got to pay; it's my right to get one hundred dollars from this house, and I'm going to get it," growls the landlord. So the tenant pays fifty dollars for the part of the house he occupies and fifty dollars for the idle part of the property.

Curious as this arrangement may seem, it is exactly what is demanded of the public today, not in the matter of rent alone, but also in the matter of the necessities of life. This analogy of conditions as presented by Walter N. Polakov, the well known consulting engineer, is an example also aptly applied to the difficult industrial situation of today.

Eight hours is the standard working day. Time-clocks in factories measure the hours, and the employees are "docked" if they do not put in full time.

The Real Cause of High Prices

The product of the manufacturing plant depends upon the efficiency of the workmen and upon the efficiency of the machine. Expensive machines are installed. Factories hold to strict account the time of employees. Do they hold to account the time of their machines?

Expert investigation has disclosed the startling fact that on an average American industries today work their men nearly 100 per cent of the working day, but that they work their machine equipment only 50 per cent of this period. The men are being worked to the utmost; machines are idle half the day. What is the result? Shoes, clothing, fuel, food—in fact, everything—is passing through a period of under-production. Agricultural implements are scarce; prices are consequently high. The farmer must pay such high prices for them that he must charge a high price for his product. His help is costly because the workers must pay high prices for their shoes, clothes, and food. Shoes and clothing are high partly because the machines are not kept busy making these products.

Instead of punching a time-clock, a workman should be held to account merely for the results of his day's work. Show the average man that his work is appreciated financially and his efforts to do better are stimulated. Browbeat him by the time-clock, and he feels free to do his work only for the sake of achieving the minimum result.

Cost of Idle Machines

When workmen are laid off, their wages stop. Human idleness costs an employer nothing. When a machine is laid off, rent must be paid for the floor space it occupies, interest must be paid on the investment, allowance must be made for depreciation of its value, and insurance must be paid.

In nearly every industry these charges are higher than the pay-roll. The fixed charges on a $10,000 machine are twice the wages of its attendant. In the blast-furnaces used in the steel industry, the "overhead" charges amount to $90,000,000, while the wages are $22,780,000. In steel-mills the cost of the burden is in excess of $250,000,000, while wages are $188,142,000. Imagine what a steel strike means in machine idleness!

Why is there a shortage and consequently a high cost of coal? In the coal industry, 50 per cent of the producing machinery remains constantly idle. The blast-furnaces of the steel industry, averaging the past ten years, were idle 40 per cent of the time, despite an acute shortage of the metal—an entirely avoidable expense, one not caused by repairing equipment or other necessary interruptions—estimated roughly to be no less than $49,500,000 in a year.

Organized labor does not object to increased productivity. Indeed, it declares that "labor is anxious to work out better methods for industry, and demands that it be assured that increased productivity be used for service and not alone for profits." (From a declaration made by one hundred and fifteen labor unions in December, 1919.) If now, on the basis of equity, we adopt the principle that *the idle capital represented in idle plants and equipment is no more entitled to any return or reward than idle labor*, we will establish a principle of fair play.

Clearly, the really effective "strikes" against production are those of the machines. Speed up production by making all the machines resound with industry. Start the cycle of industry in the factory. There is plenty of wealth for all; the country is rich in natural resources. But, with overworked human beings and underworked machines, there may be plenty of profits for a few people, but the lack of production puts a burden of hardship on the commonwealth.

In 1918 a ton of bituminous coal sold at the mine for $1.32, yet the combined wealth contained in this ton of coal had a collective value of at least $16! In terms of cash, the value of the 50,000,000 tons of coal wasted yearly in power production alone—not taking into account the large tonnage wasted in connection with other uses—was $65,000,000 at the colliery. The value of the by-products of this coal would be more than $800,000,000.

In terms of social value, the same coal wastage represents a loss of 500,000 tons of ammonium sulphate, 100,000,000 gallons of benzol, and 400,000,000 gallons of tar. Transferring these amounts into other values, we find that the nitrogen contained in 500,000 tons of ammonium sulphate is capable of raising the production of wheat by 43,316,000 bushels, based on 115 pounds of nitrogen to the acre. Benzol is equivalent to gasoline, and the above amount is valued at about $30,000,000 — representing, roughly, 2,000,000 miles of five-ton truck travel. The 400,000,000 gallons of tar would make possible the extension of rural highways and keep the existing roads in good condition. The foregoing three examples concern only the primary products, while there are other chemicals, drugs, dyestuffs, etc., that could be extracted. But the greater part of this value has been paid for by the public without a return in service.

How Workmen Check Time Waste

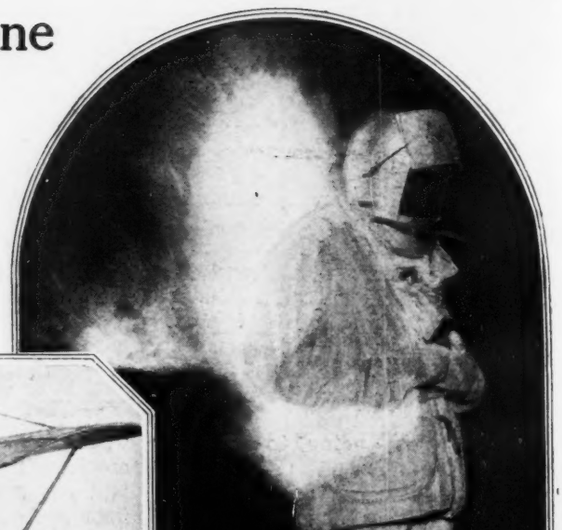
Mr. Polakov told the writer about a plant in New Jersey where an efficiency chart is kept by the men themselves. If a machine is idle, the chart shows it, and the remedy is at once found. If the delay is due to shortage of labor, word is carried to the employment manager. If the delay is due to shortage of material, a tracer is sent out.

"Assume that the idleness of a machine is due to lack of a certain raw material," said Mr. Polakov, "the word is taken to the general manager. He looks at his map, where colored pins mark whence the company receives each product required in its industry. He discovers that the particular material has started from a certain point. A quick summons brings the expert tracer. He finds exactly where the car of material is stuck, and if necessary provides men to get the raw material from the sidetracked train.

At Last—the Fireproof Airplane

This invention of an American promises to make the airman's vocation a comparatively safe one

One of the greatest recent developments in the science of flying is the fireproof airplane, the invention of Parker R. Bradley, of Nutley, New Jersey. An ordinary airplane is rendered fireproof by the application of a fireproof "dope" and paint. Then, after spraying with gasoline, as shown in this picture, it is set on fire. In experiments carried on at Hazelhurst Field, Long Island, the invention has stood the most grueling tests that the government officials could devise



Mr. Bradley has also invented a fireproof suit for the use of firemen and airmen.

The picture shows such a suit apparently being consumed by fire. It is really only a coat of gasoline that will burn off without injury to the suit or its wearer. Airmen dressed thus may soon be a common sight

This airplane has been the subject of repeated experiments with the fireproof "dope" without damaging its fabric. Aeronautical experts consider that this, when used with the fireproof suit and tank, will make flying comparatively safe. The fireproof tank, which Mr. Bradley invented in the last year of the war, is also heatproof, and its construction is such that bullet-holes close up automatically

Popular Science Monthly

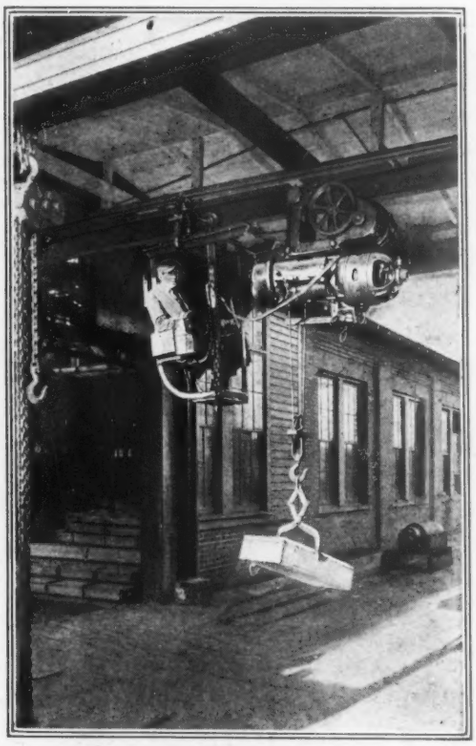
Reducing the Handling Cost from Dollars to Cents

ELECTRIC cranes hoist and transport loads that would take many men, tugging and lifting, hours to move. Industrial efficiency depends upon the speed of transportation, outside and inside the factory.

The economic importance of the electric crane can not be overestimated. A small electrically propelled crane can do the work of at least ten men provided with hand-operated hoists. Cases have been known where it cost sixty-seven cents to handle a ton of material by the antiquated method of hand hoists. By the use of the rapid, smooth-running electrical hoist, this cost was reduced to a few cents a ton. This was aside from the added advantage of greater speed, which also represents a saving.

The electric hoist runs on an "I" suspended from the ceiling. This saves floor space, since it is not necessary to keep clear the floor over which it passes. A path must be kept clear when a hand-operated hoist is employed.

The little shop electric crane is a veritable Hercules. With it a man can lift a weight from ten to twenty times greater than he could lift with an ordinary hand-chain block. Not only this, but he can move the load from one part of the factory to another in the twinkling of an eye.



A Hercules of the workshop. It can hoist 3000 pounds and carry it 200 feet a minute

The electric hoist can pick up a load of three thousand pounds and speed along the beam with it at the rate of two hundred feet a minute. The driving motor is under perfect control at all times by the crane operator, who sits in a little steel cab high above the ground. At each side he has a controller. He is able to control the lifting with one hand and the travel of the crane along the beam with the other. Two heavy duty electric motors are used on each crane. One moves the crane along the mono-rail, and the other does the lifting. Thus, once the load has cleared the floor, the operator can start the crane, hauling up the load as it moves along.

All vital parts of the crane are enclosed to exclude dust. Both motors are under perfect control, and they are very sensitive to the slightest movement of the controlling handles.

Mental Tests for the Clever Ones

IN Europe a method has been adopted for selecting school-children of the highest mental ability in order that they should not be held back in their studies by slower minds.

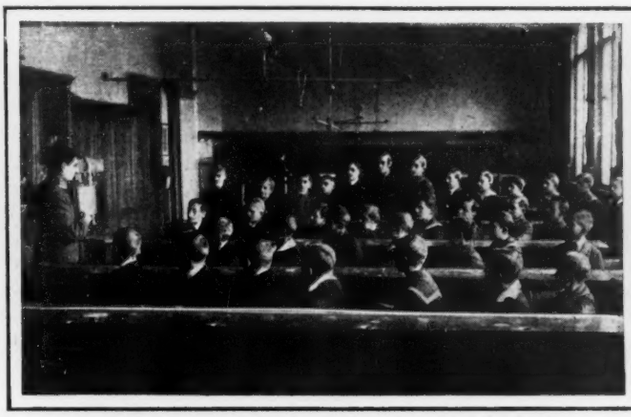
The pupils' powers of concentration and observation are tested by the experiments represented in the photographs below. The pupils are shown an engine model of a design simple enough to be understood without technical knowledge, and which a clever boy (contrary to most girls) usually has no difficulty in interpreting. Next, the children are shown pictures of animated scenes. These they are permitted to look at for only a short time. Half an hour later they are asked to write their impressions.

In the latter test the girls usually show a superior keenness.

To test their judgment, the pupils are given certain situations or problems of every-day life, and are asked how they would solve them. Then problems with several solutions are presented, and they must choose the best solution. The clearness of ideas is tested by a request for concrete and abstract definitions; the promptness of ideas by the association of a word with related notions.

Their power of concentration is tested by asking the children to strike out certain letters or combinations of letters from given words. To test their memory, they learn by heart a set of syllables devoid of any sense, as well as connected texts, thus testing the retentive faculty as well as the speed of memorizing.

After the results of these tests are gaged, the cleverest pupils are recommended for promotion to special schools.



A model is shown, and the pupils give their idea of its use and workings. Boys usually grasp the mechanical idea better than girls

A picture is shown, and the pupils write their impressions of it. Here girls do better than boys in their observation of details

Out of the tall office-buildings pour the crowds of passengers who ride in the "vertical railway systems," the elevators. In New York city more than twice as many passengers are carried vertically as are conveyed on the elevated trains, the surface-cars, and the subways

Safety for Passengers Who Travel Vertically

How the modern elevator is safeguarded

By Latimer J. Wilson

NEW YORK, the tallest city in the world, has nearly a hundred buildings twenty or more stories high. If these structures were piled on top of one another, they would reach the clouds, where eternal snow would crown them. The total height of the skyscrapers of Manhattan is more than five miles, or nearly equal to the altitude of Mount Everest, the earth's most lofty mountain.

Millions of people are carried every day by street-cars, subways, and elevated railways through the thoroughfares between and under the tall buildings.

In the dark canyons between the lofty structures flow other streams of humanity. But in the buildings themselves is a most remarkable "railway" system that carries daily more than twice as many passengers as all the other lines combined. It conveys them vertically instead of horizontally, and has a greater factor of safety than any other transportation system, notwithstanding the fact that thousands more people are involved.

More than seven million people are within twenty miles of New York's City Hall, a population nearly as great as that of the whole of Canada, and equal to that of half a dozen of our states combined. The traction lines carry daily about five million people, while the vertical "railways," the elevators, carry twice this number at least.

At the top of the elevator-shaft is a speed governor which spreads as the speed of a car increases. This automatically controls the switchboard and regulates the speed

Every time a man rides in a conveyance he is counted a passenger. In the subway, the surface-car, or the elevated, he rides from his home to his place of business and back each day; but in the elevator he makes two additional trips at noon; he is a passenger in the elevator four times daily, but only twice daily in the "horizontal" lines of travel. There are more elevator passengers than others, yet seldom are there accidents resulting in death or injury. In the eleven years from 1907 to 1918 fewer than ninety people were killed in freight and passenger elevators throughout Manhattan.

Compare this figure with the casualties of the short interval of one year and seven months, a period equal to

the duration of our participation in the world war. In that time 126,000 persons were killed in the United States; 35,000 in industry and 91,000 outside of industry, of which about 19,000 were automobile accidents. What makes the elevator a safe conveyance, traveling hundreds of feet vertically along its peculiar track at a speed of six hundred feet a minute?

There are the local elevators and the express elevators, those that run twenty-eight stories without a stop and those that stop at every floor in shorter runs. All day they are making continuous trips, yet there is seldom even a delay in their operation, and the chances of an accident are exceedingly remote. What makes an elevator so reliable and so safe?

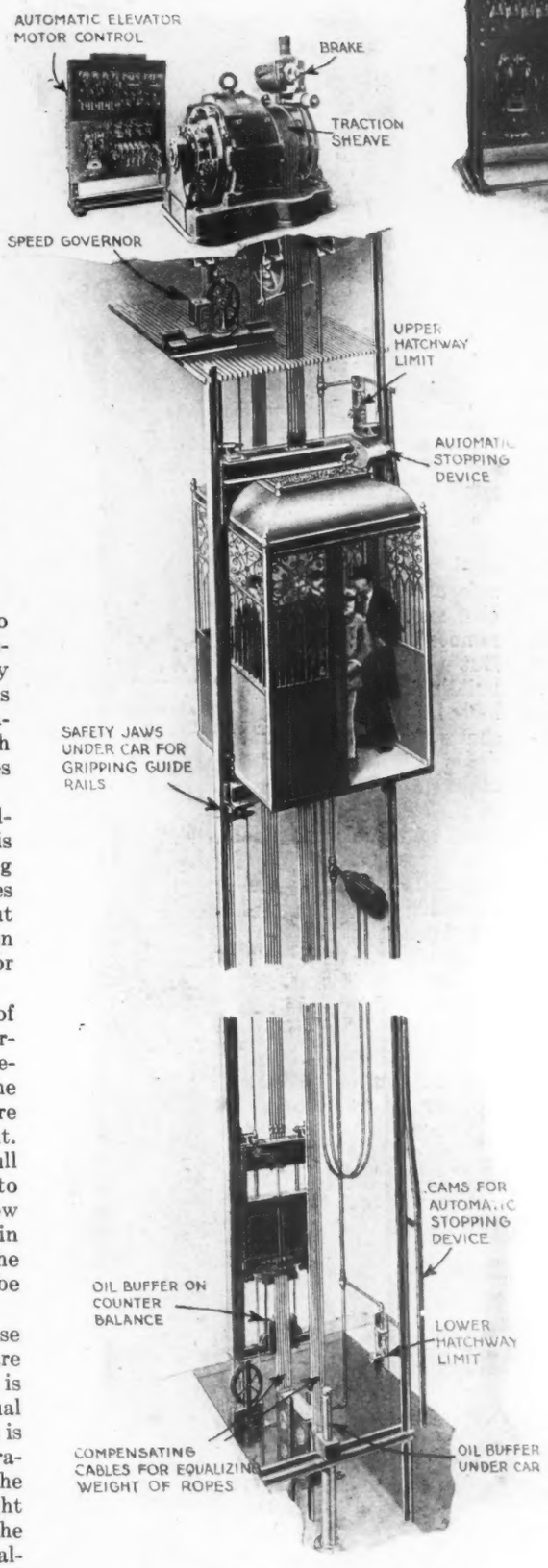
Seven Safety Devices

On the modern elevator no fewer than seven mechanical devices are used which assure safety and convenience. New York has more than ten thousand passenger elevators, all equipped with safety devices; the law requires it.

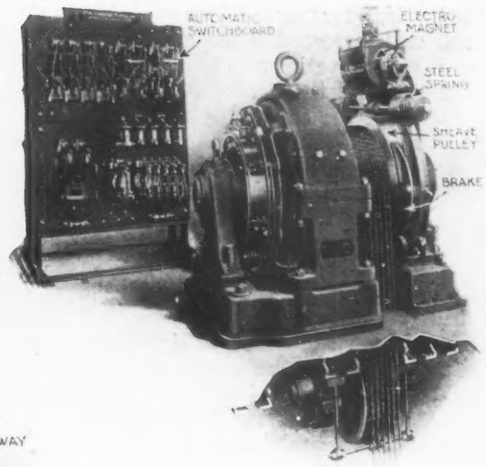
The factor of safety in buildings and bridge construction is such that every part of a building must carry from six to eight times its so-called "safe load." But elevators have not less than ten times the strength required for their limit of safety.

Raise and lower the window of your room, and you have operated the simplest kind of an elevator. The cords attached to the window pass over a wheel and are connected with a counterweight. It takes as much power to pull the window down as it takes to raise it, because when the window is lowered, the counterweight in the sill-frame that balances the weight of the sash must be lifted.

With an elevator-car, whose weight varies as passengers are conveyed, the counterweight is made heavier than the actual weight of the empty car. This is done to effect economy in operation as the load carried in the car varies. If the counterweight and empty elevator were of the same weight, they would be balanced as is the window-sash and its counterweight. But when the car is full of passengers, a greater strain would be thrown upon the motor than occurs when the counterweight is made slightly heavier to allow for an average number of passengers.



Life is full of ups and downs for the operator of an elevator-car. He travels hundreds of feet up and down the shaft, but he is guarded against a possible accident by various safety devices that are installed along this the safest of all railway systems



At the top of the shaft is the revolving sheave around which the cables pass. Near by is the automatic switchboard

Experiments with fully loaded cars have been made by cutting the cables and allowing the car to fall, in order to determine the proper distance in which to stop the car without injury to the passengers. It was found that it is not safe to permit the car to stop too suddenly, even in a short drop. If an elevator falling freely for one hundred feet were to be stopped within twenty-five feet of the ground, it would have to lose speed four times as fast as it had gained speed, which is equivalent to adding four pounds of weight to every pound of the passengers' weight. Thus a man who weighed one hundred and fifty pounds would have to support on his legs a weight of equivalent to six hundred pounds additional to his normal weight if the car came to a stop in the short space of twenty-five feet. His frame can support the six hundred pounds if he stands erect. But if he sits in a frail chair, this enormous addition of weight would crush the chair and dash him upon the floor of the car.

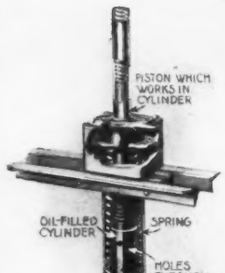
The Speed Governor

But the modern elevator is so arranged that the car can not gain such headway. It is automatically brought to a comfortable stop soon after it surpasses a certain speed limit. A speed governor is attached to the car, spreading outward as the car runs up or down. When the governor has opened a certain degree, it automatically operates the electric switchboard at the top of the shaft. If the speed becomes excessive, more than six hundred feet a minute, a contact on the

January, 1921

governor closes, thus reducing the speed. If, for some reason, the speed still increases, a second contact opens, disconnecting the current from the motor and the brake through the operation of the controller, thus stopping the car. But if something has broken and this mechanism fails so that the car attains a speed of about eight hundred feet a minute, a safety rope unwinding around a grooved drum under the car quickly throws outward two brakes that grip the rails to bring the car to rest.

Then there are other devices that will not permit the car to run into the overhead mechanism should the operator fail to stop at the top floor. At the upper and lower limits of the hatchway are devices which automatically bring the car to a gradual standstill, in case the operator fails to stop the car. But if there should be an unusual happening to send the car beyond these devices, there is a final hatchway limit equipped with an automatic mechanism which instantly cuts off the current from the motor and applies the machine brake. In the bottom of the shaft is an oil cushion buffer, under the car and under the counterweight, bringing the car to a gradual stop, in case the car reaches the bottom of the shaft at a speed too high, and yet not sufficiently high to operate the governor tripping device.



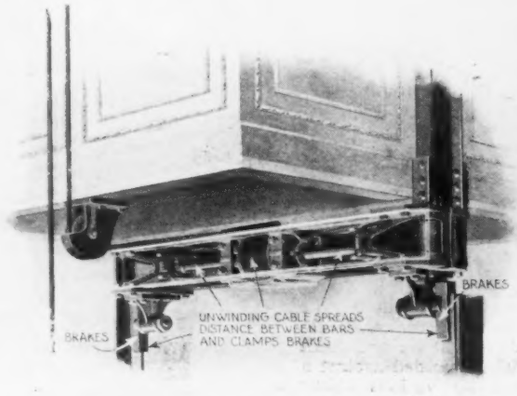
When the car strikes the oil buffer, it compresses the oil in a cylinder, pressing it out through graduated holes, the buffer thus acting as a cushion beneath the car. A similar buffer is placed under the counterweight

What the Oil Buffer Does

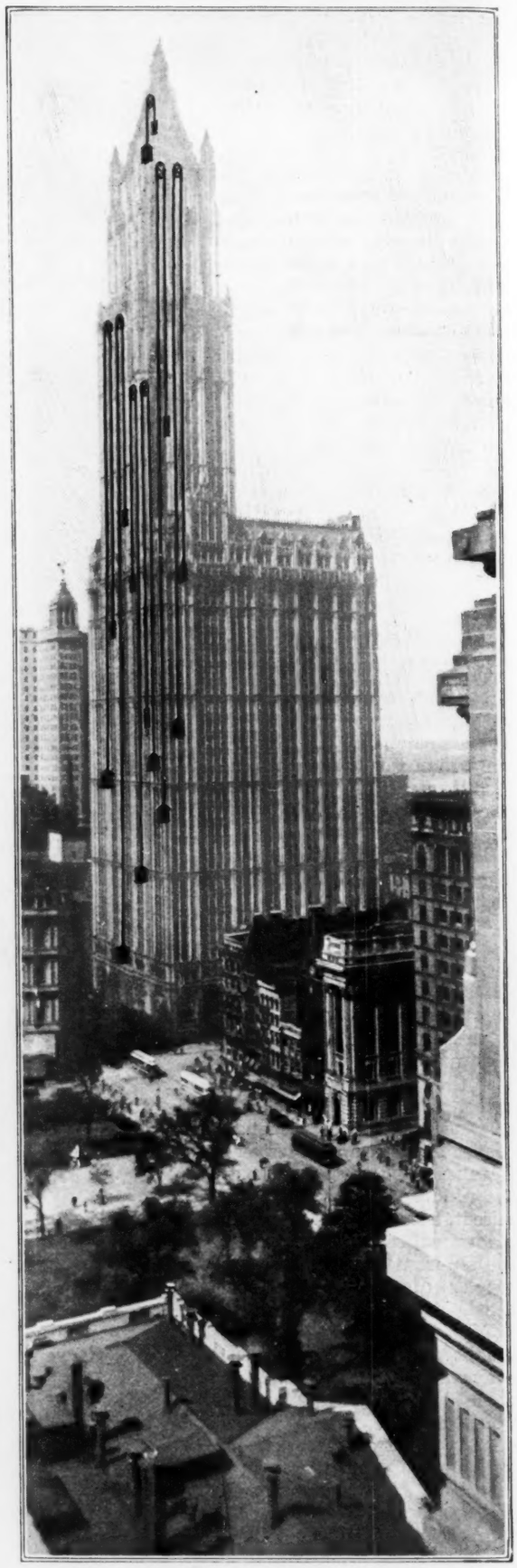
It is easy to see what would happen if an elevator-car should get out of control, starting to drop at a rate anywhere between six hundred and eight hundred feet a minute. Now, if the tripping device operating the brake under the car were the only means of bringing the car to a stop, and if this device were set to operate at eight hundred feet a minute, the car might reach the bottom of the shaft before it had attained sufficient speed to operate the brake. A drop of only three or four stories would be a decidedly uncomfortable one to be halted suddenly at the running speed to even six hundred feet a minute. Thus it is that the oil buffer at the bottom of the shaft is an added safety factor designed to meet any emergency brought on by a possible failure of some part of the mechanism at a critical moment.

Not all elevators are equipped with all of the safeguards that make the chances of accident too remote to be considered. But the modern office-building, towering into lofty heights and having shafts extending hundreds of feet, necessarily takes no chances. Here all the safety devices are used, and the accidents that occasionally happen in such buildings are those due to persons falling down the shaft or to workers who are careless.

The actual drop of a car with a crash is practically an impossibility. The automatic devices are preventives more certain obviously than the block signals on a railroad system, furnishing a degree of safety that is amazing.



Under the car are the jaws that grip the rails when the elevator exceeds a maximum speed



Here is shown the various length of the "runs" of the elevator-cars in the tallest building, but it has many more shafts than are indicated. Throughout the hours of the business day thousands of passengers are conveyed safely up and down. There are twenty-six elevators in the Woolworth Building

The Typical Airplane Motor of Today

Aeronautical experts are attempting to standardize it

By C. Dienstbach

IF the heart of a man is an imperfect organ, refusing to do its work of properly pumping the blood through the body when unusual conditions prevail, such as are met in stunt flying, that particular man can not be an aviator. So it is with the engine of an airplane. The engine, cooled by water jackets, and kept in running order by the flow of lubricating oil pumped into its operating mechanism, is somewhat like the human heart. If the flow of this oil is interrupted by an abnormal position of the machine, then that particular engine is not suitable for work in the air.

The Motor's "Circulation"

Here is an airplane engine with a pump at each end of the crankcase to aid perfect running during stunt flying. Oil is thus kept in circulation intact in abnormal positions. No "rush of blood to the head" is possible with this mechanical imitation of the animal mechanism, for the two pumps keep an even circulation of the vital lubricating fluid.

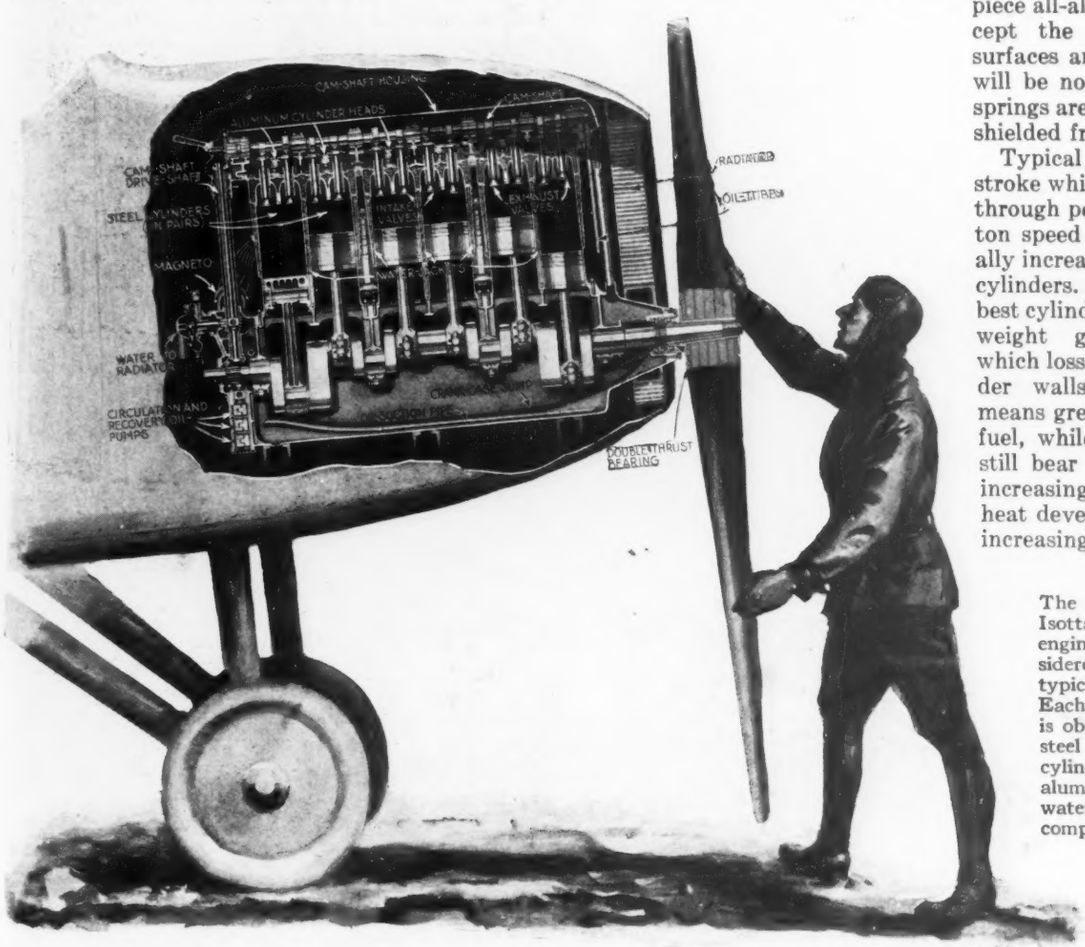
The pilot's winged chariot is driven through the air by "horsepower." It is curious to consider how the modern airplane motor repeats history. The inventors of the automobile considered four to eight horsepower more than sufficient for the first automobiles. They argued that if two horses could draw a carriage, the power of from four to eight would be ample for an automobile. But to-day a whole stableful of horsepower is used for pleasure vehicles, while racing machines use considerably over a hundred horsepower. Similarly, the power for the typical airplane has risen from twenty to more than one hundred and fifty.

The V-6 type of the Italian Isotta-Fraschini engine develops at normal speed from 250 to 260 horsepower. It is a two-stroke vertical six-cylinder water-cooled engine, which at normal speed gives the propeller 1650 revolutions a minute, and is capable of 1850 revolutions a minute at 275 horsepower. Rated at 260 horsepower, the engine weighs only two and one half pounds to the horsepower. Like other modern motors, this engine has its valve-operating mechanism next to the valves themselves, the camshaft being right on top of the cylinders, because this gives always the same action in spite of vibration and is almost free from wearing influences.

The Perfection of Engine Detail

Those who are familiar with gasoline engines will recognize a noteworthy feature in the design of the cylinders of the V-6. These are composed of matched pairs from a steel ingot, and are complete with their combustion chamber and valve seats. Each pair of cylinders has a head from a single aluminum casting bolted on to the cylinder itself. The valve guides are contained in the cylinder heads, as are also the induction and exhaust ports, the camshaft, as indicated, resting upon the cylinder tops. Steel water jackets surround each pair of cylinders, being screwed on the base and head of the cylinders. As seen in the picture, cavities for the cooling water surround the valves' bodies, including nearly the whole stem of each valve. Since the exhaust valves are the most taxed, this system shows a decided gain in reliability, and it could be combined eventually with a one-piece all-aluminum design (except the lining of rubbing surfaces and valve seats). It will be noted that the valve springs are also thus positively shielded from heat.

Typical also is the long stroke which gives more power through permitting higher piston speed than it proportionally increases weight by longer cylinders. There is a certain best cylinder bore for the lightweight gasoline engine at which loss of heat to the cylinder walls is lowest, which means greater power for little fuel, while the cylinder can still bear up under the ever-increasing relative quantity of heat developed in cylinders of increasing size.



The Italian V-6 type Isotta-Fraschini airplane engine might be considered in many ways a typical airplane motor. Each pair of its cylinders is obtained from a single steel ingot, while the cylinder heads are from aluminum castings. The water-cooling system is complete

The Electrical Effects in "Mecca"

Using colored lights like paints on an artist's palette

By Latimer J. Wilson

IN the electrical effects of the gorgeous Oriental play, "Mecca," at the Century theater, New York, E. Braun, the chief electrician, has made use of colored lights as an artist makes use of colors on a palette.

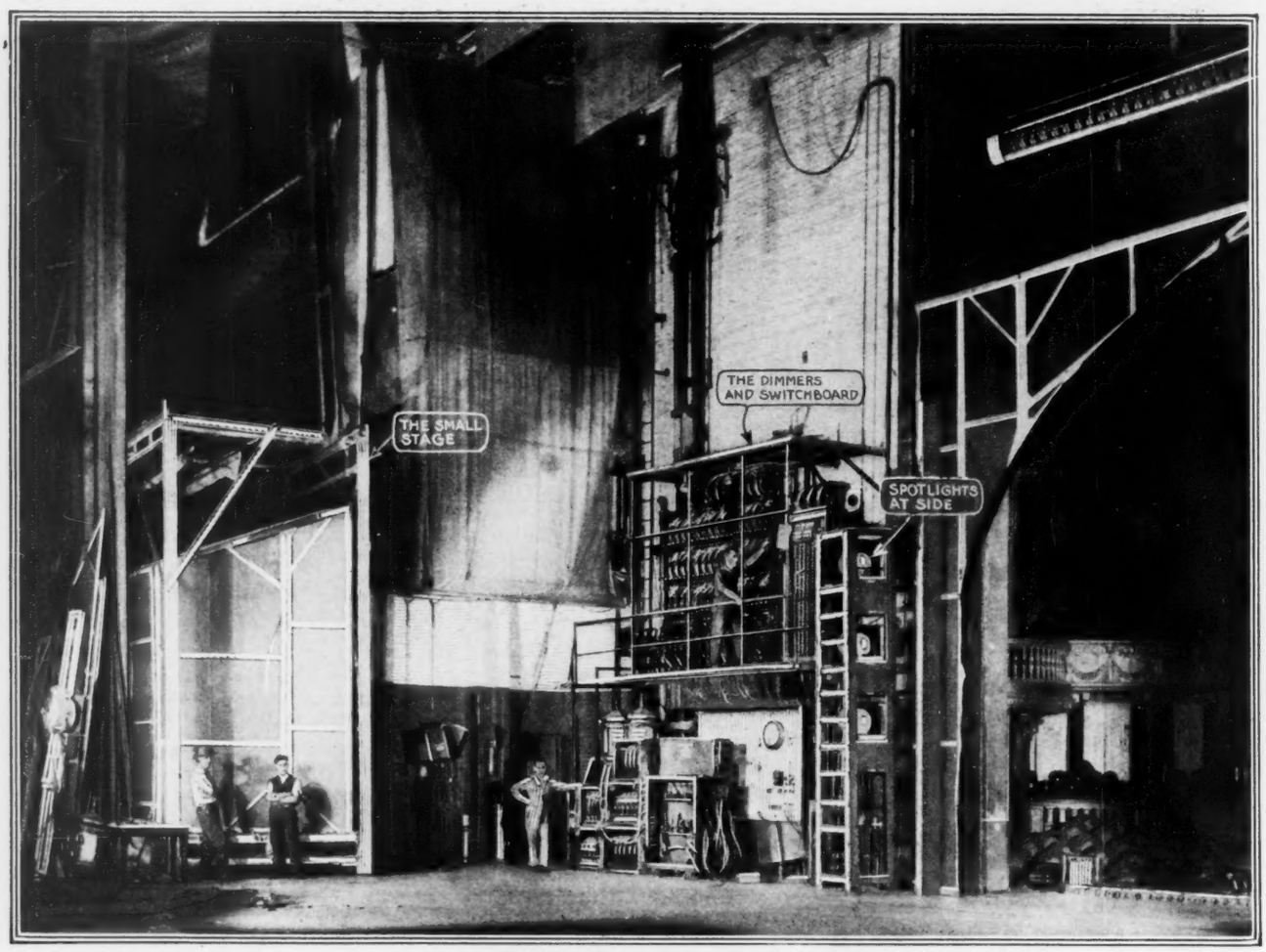
The scenery depends upon light for its effectiveness. How different is the same scene exhibited with different angles of illumination and in different colors! Nature's outdoor lighting comes from the sky, so the scenes of "Mecca" are lighted from above and footlights are practically dispensed with.

The rays of morning stream slantingly across the scene, realistically producing the effects of sunrise. When the sun is low, its rays are red or amber, and the shadows are colored by light reflected from the overhead region of the blue sky. This is simulated on the stage by the use of blue lights hidden in the "drops" above, and intensified by strong lights shining through blue filters obliquely from the side opposite the rising sun.

But how are these lights so regulated that they are neither too bright nor too dim, and how can they be changed from dim to bright? Look at the side of the proscenium from behind the curtain. There is a vast array of "dimmers," controlled by the switchboard at which men are standing throughout the performance. These dimmers are specially devised transformers that alter the resistance to the electrical current. They cause the light to grow gradually from a faint incandescence to full brilliancy. More than half a hundred thousand-watt lamps are used, besides a number of sunlight arc-lights, spotlights, etc.

A unique mechanical effect employed in "Mecca," appropriate for this Arabian Nights type of play, is a substitute for the ordinary front drop used in most plays to cut off the stage while the scene is being shifted. At the close of a full-stage scene, a special drop-curtain is lowered, having in its center an opening less than half as

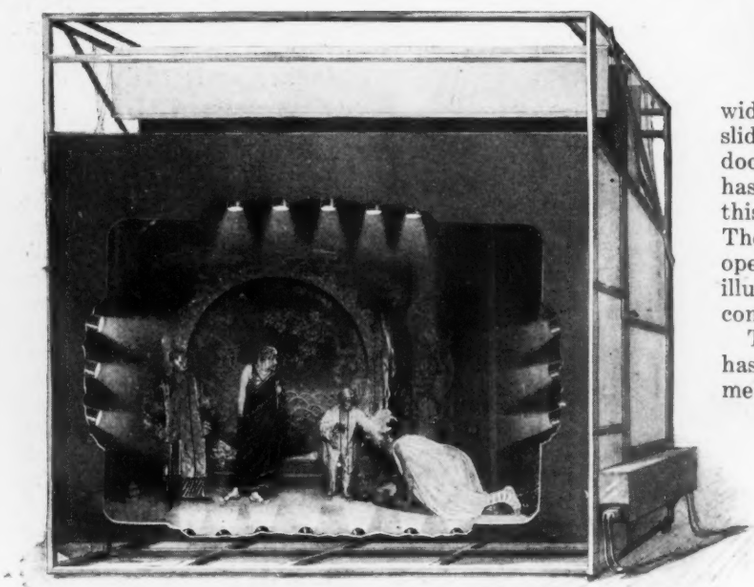
Thin copper strips illuminated from below and raised by a small motor, while smoke powder is burnt on a hot resistance wire, constitute the "torch" in "Mecca"



The small stage at the left is "set" as an intermediate scene to be rolled out to the front of the large stage. The dimmers and spotlights are seen at the side of the proscenium

This illustrates the dramatic lighting by spotlights and overhead lamps in the production of "Mecca." The unnatural effect of footlights is eliminated. Here the morning sun rays are represented by the arc spotlights at the right of the stage. Amber gelatine filters are superposed before the side spotlights

The fountain in "Mecca" is really a perfect mechanical fountain whose pressure is supplied by pumps under the stage. The water leaves the fountain basin through a drain and runs into an overflow tank under the floor from which it is drained by a pipe extending into the regular drainage system

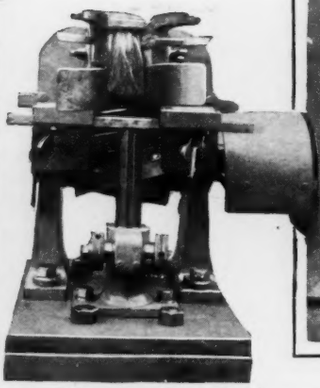


Here is a scene on the small stage, "set" while at the side of the large stage. When the special drop-curtain is down, it is rolled into place in the front of the large stage and the two screens in the middle of the curtain are slid apart

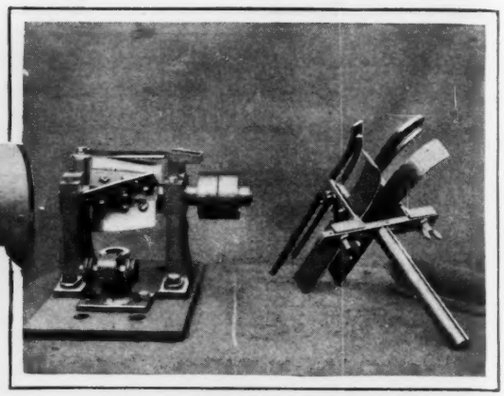
wide as the full stage. This opening is covered by two sliding screens, which operate from the side like sliding doors. A small stage built upon a platform on rollers has previously been set for the scene to follow, and this is rolled into place behind the special drop curtain. The lights are turned on and the sliding doors are operated, disclosing to the audience the brilliantly illuminated little stage, with its characters in place to continue the play.

The small stage is fully equipped electrically. It has its own switchboard and set of dimmers. The mechanical construction is exceedingly simple, and the frame can be quickly taken apart so the small stage can be shipped conveniently with the scenery from one city to another as the company travels about the country. Such an independent mechanical arrangement should meet the demand for amateur and small-town theatricals. It is so compact that it can be kept in the basement of a college or church, and easily assembled and made ready for the Christmas or commencement play, and for the numerous "little theaters" that have sprung up, it is invaluable

It is possible, with this invention, to trim twenty dozen brushes an hour in place of the five dozen done by hand



A brush-making machine so simply constructed that a blind man can operate it



The machine is built on the plan of a lawn-mower. Four paddles operate against the edge of a stationary knife

Trimming Brushes by Machine

A SMALL and simple machine—so simple that it may be operated by a blind man without risk of injury—has been invented by M. Vollet, a French engineer, for trimming the bristles or vegetable fibers of brushes.

Heretofore an experienced workman was able to trim five dozen brushes an hour by hand. With Vollet's machine a blind man can trim twenty or more dozen brushes in that time in spite of his handicap.

The machine is built on the plan of a lawn-mower. Four paddles, set at an angle, are fastened to the shaft, with their outer edges operating against the sharp edge of a stationary knife. In front of the cutter an adjustable guide is fixed.

The brush to be trimmed is placed in a groove of the guide and pushed toward the knife. The revolving paddles press the brush part against the knife edge, which cuts the bristles, horsehair, or vegetable fibers at the proper distance from the back of the brush, which is then slipped out at the opposite end of the guide.

By modifying the guide member, the machine can be adapted for the trimming of curved or irregularly shaped brushes.

This Plow Has a Great Appetite for Snow

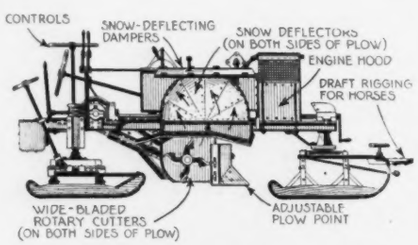
THIS plow is a hard worker. It bites into the deep snow like a hungry demon. Six horses are required to pull it, but the horses do not furnish the motive power that actually removes the snow. A sixty-horsepower gas-engine does that.

The engine is mounted upon the steel frame and connected by chain drive with the two fast rotary cutters at each side. They cut into the snow and lift it high into two deflecting hoods placed above. The snow is discharged from the hoods as fine dust clouds at both sides of the walk. The rotary cutters are adjustable in order that the depth of the cut may be regulated.

The cut made measures five and one half feet in width. The plow has been used in certain Canadian cities in removing a snowfall as deep as three feet. In extreme cases, the rotary plow has been able to work its way through snowdrifts as deep as six feet.

The plow can also be used on the street since it cuts a clean channel wide enough to accommodate a single line of traffic. If such a channel is cut on each side of the street, traffic can be resumed with very little trouble.

Two drivers for the horses are needed when the machine is in operation. An operator for the plow is also necessary. It is the task of this man to adjust the cutters and keep the gasoline engine in operation.



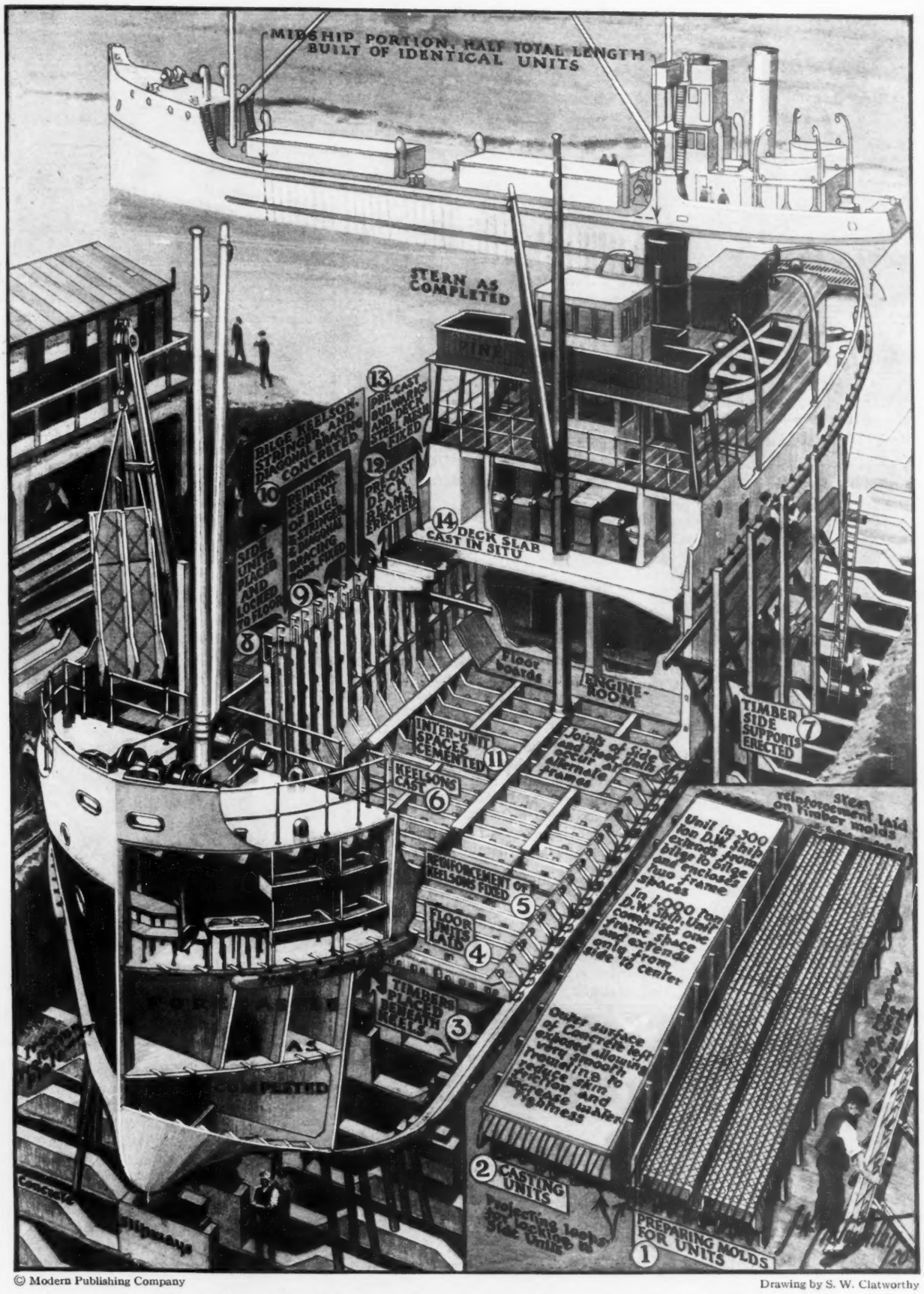
A sixty-horsepower gas-engine, mounted on a steel frame and connected by chain drive with the cutters furnishes the power

In a test made at Westmount, Canada, the machine removed one thousand cubic yards of packed, frozen snow at a cost of thirty-five dollars and fifty cents. It would have cost fifty-three dollars to have removed the same amount of snow by hand shoveling. The hand method of removal also would have taken much more time.

When the snow is too deep for horses to draw the rotary plow, a small tractor can be used. In the case of a tractor being used, only two men are necessary to handle the outfit.

During a really heavy snowfall this new plow was able to keep twelve miles of sidewalks clean at a cost of thirty dollars and forty-five cents a day. The number of men it would replace in a case like this would depend entirely upon the depth of the snow and the rapidity with which it was falling. In a heavy fall it would probably replace a small army of men and save at least half of the cost in removing the snow from the streets. In country districts, where men are scarce but roads must be kept open, this plow would be invaluable.

Rotary cutters bite into huge snowdrifts, cutting into the snow and lifting it high into two deflecting hoods placed above; it is discharged from the hoods in fine dust clouds


MIDSHIP PORTION, HALF TOTAL LENGTH BUILT OF IDENTICAL UNITS
STERN AS COMPLETED
13 PRE-CAST BULWARKS AND DECK STEEL FRESH FIXED
BILGE KEELSON, STRINGER AND DIAGONAL BRACING CONCRETED
10 REINFORCEMENT OF BILGE, STRINGER & DIAGONAL BRACING POURED
12 PRE-CAST DECK BEAMS ERECTED
14 DECK SLAB CAST IN SITU
SIDE UNITS PLACED AND LOCKED TO FLOOR
9
8
Floor boards
ENGINE-ROOM
TIMBER SIDE SUPPORTS ERECTED 7
INTER-UNIT SPACES CEMENTED 11
KEELSONS CAST 6
Joints of side and floor units occur at alternate frames
REINFORCEMENT OF KEELSONS FIXED 5
FLOOR UNITS LAID 4
TIMBERS PLACED BENEATH KEELS 3
Steel reinforcement laid on timber molds
Unit is 200 ton D.W. Ship extends from bilge to bilge and encloses two frame spaces
In 1,000 Ton D.W. Ship Unit comprises one frame space and extends only from side to center
Outer surface of concrete left exposed allowing very smooth Trowelling to reduce skin friction and increase water tightness
2 CASTING UNITS
Projecting loops for locking to Side Units
PREPARING MOLDS FOR UNITS 1

© Modern Publishing Company

Drawing by S. W. Clatworthy

A Thousand-Ton Concrete Ship Built in Units

CONCRETE ships are not new. We are familiar, more or less, with the pre-cast plate method, the monolithic hull, and the upside-down boat. But now comes the concrete ship built in units, with a resulting hull lighter than wood and more shipshape in appearance than the earlier concrete types. Moreover, it is admirably adapted to use as a motor-ship

In Great Britain these motor-ships are being manufactured with a dead-weight capacity of from three hundred to one thousand tons. They are becoming very popular there, and will probably be so also in the United States.

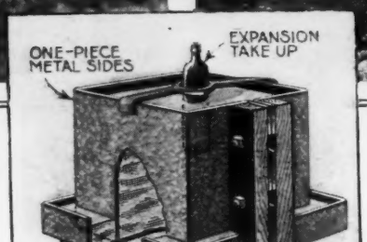
The drawing is numbered to show the order in which the units are cast and put together to produce the pleasing result shown in the detail at the top of the page

Courtesy of U. S. Forest Service

Putting Out Forest Fires

FIREFIGHTERS trying to stem the roaring flames of the burning forest dash toward the clearings where the tall grass may be burned ahead of the fire to prevent a new nucleus of a conflagration from being started.

In fighting the forest fires and in controlling the areas that are purposely being burned, a type of fire-wagon is employed which conveys a water-tank on the bed of the wagon. A pipe runs from the back of the tank so that the buckets of the fighters can be quickly filled. With the continuous supply of water furnished by several of these wagon-tanks, a number of firemen can be kept busy with the buckets. This arrangement is also good for the farm where large tracts of stubble land are burned.



A Mechanical Coal-Picker that Hastens Production

GOOD coal, bad coal, and slate are all mixed together when they come from the mines. Later they have to be separated either by hand or machinery.

Slate is heavier, rougher, and flatter than coal; thus it moves more slowly. The sorting machine below takes advantage of this. The coal and slate are released at the top of the chutes. After they have traveled a short distance, they come to a roller which they must pass over. Just beyond the roller there is a slot. The coal, being light and speedy, jumps across the slot and continues on down the chute; the slate, being heavy, falls through.

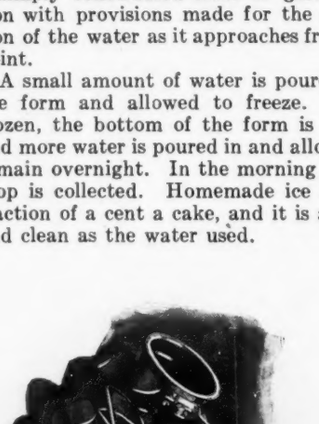
As the coal continues on its way down chutes and over rollers until all the slate is gradually eliminated, breaker arms retard its progress to prevent it from gathering too much momentum. Levers at the sides of the chutes enable the operator to adjust the chutes to any angle, thus regulating to some extent the speed of operation.

You Can Make Your Own Ice

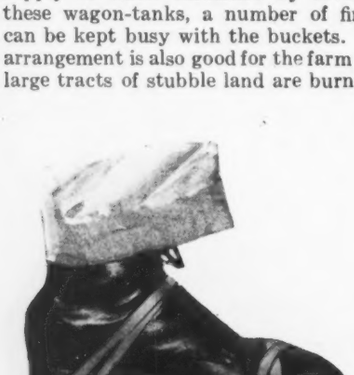
THE price of ice continues to rise with the rest of life's necessities. This invention will solve the ice problem for those who will go to the trouble of constructing an icehouse.

The device is nothing more nor less than a simply constructed form of galvanized iron with provisions made for the expansion of the water as it approaches freezing-point.

A small amount of water is poured into the form and allowed to freeze. When frozen, the bottom of the form is sealed, and more water is poured in and allowed to remain overnight. In the morning the ice crop is collected. Homemade ice costs a fraction of a cent a cake, and it is as pure and clean as the water used.



© Keystone View Company

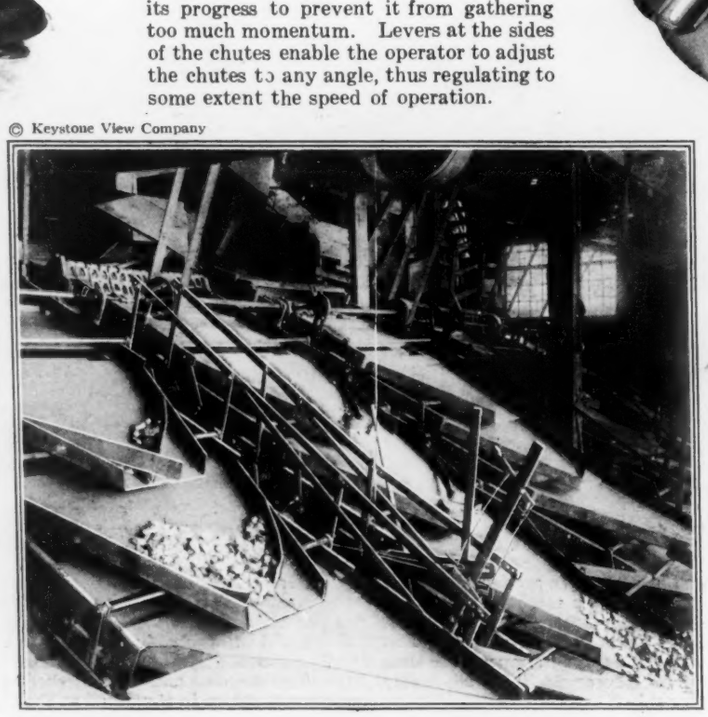


Rubber Bands for Rainy Days

IF you don't like to wear rubbers in rainy weather, perhaps you will wear rubber bands instead—not the ordinary kind with which you fasten packages, but great thick ones that you wrap separately around the toe and heel of each shoe. Mr. Almeron H. Perry, of Washington, D. C., thought of this idea.

The bands have thick, rough treads that touch the ground and raise your feet out of water's way. Each band is of double thickness to make it secure, and it is fastened across the top of your shoe by means of a hook and eye such as are used on women's clothes.

© Keystone View Company

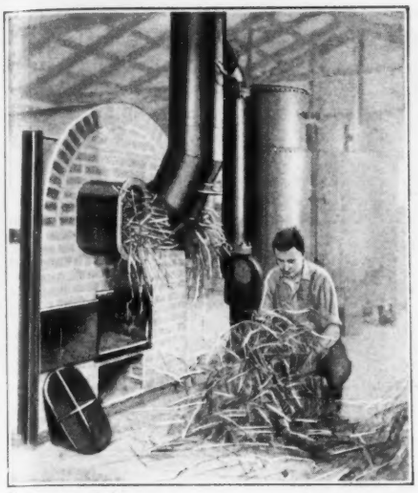


Glasses for Testing Chimney Smoke

YOU guessed right. This is some kind of a 'scope—an umbrascope. It is used in large cities to see that industries do not discharge more smoke into the atmosphere than is lawful.

At one end of the umbrascope there is a small peephole. At the other end a piece of colored glass is in place. The device is provided with four pieces of colored glass, used either independently or together.

The density of the smoke is determined by comparing its color with the glass. If the color of the smoke is darker than a certain piece of glass, the factory owner is warned.



© Harris & Ewing

Making Gas from Straw

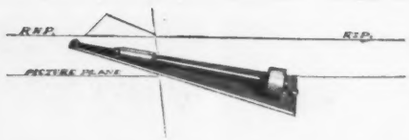
OAT, wheat, and rye straws, when intensely heated in a closed compartment, give off a gas that can be used for illumination as well as power. Six years ago George Harrison, a Canadian engineer, developed this new fuel, which at present is being subjected to experimentation and further development by the United States Department of Agriculture.

Although from fifty pounds of straw three hundred cubic feet of gas can be made, as yet there has been found no convenient way to carry it. If the gas can be condensed into a liquid motor fuel and thus conveniently used, the farmers of the Northwest will consider waste too valuable to destroy.

Imitation Animal Tracks

AN increasing number of fur-bearing animals must be trapped to supply the demand. Here is the latest way of trapping them.

Mr. Raguvald Leland, of Birch Hills, Canada, has invented a luring-machine. Animals will invariably follow footprints made by one of their kind; this machine turns out imitation footprints. It is a sled with spurred wheels on either side. When Mr. Leland pulls the sled across the snow, the wheels turn and actuate a pair of imitation feet that extend beyond the rear end of the sled. They are coated with animal fat so that the keen nostrils of the animal will not detect any strange odors. The man's footprints and the tracks made by the runners on the sled are obliterated by a scraper at the rear end of the sled.



To Simplify Perspective Drawing

TRACKS seem to approach each other as you look down them, until, at a vanishing point, they seem to touch.

Perspective drawing is the art of picturing things on a plane surface as they appear to the eye, and in consequence there must be a left and a right vanishing point.

W. A. Moore of Welland, Canada, has recently invented a rolling perspective ruler that eliminates much of the work necessary in perspective drawing. The rolling ruler is mounted on a flat base that has scales on the edges. One end is fastened to the paper at the vanishing point, and the other end is left free to rotate.

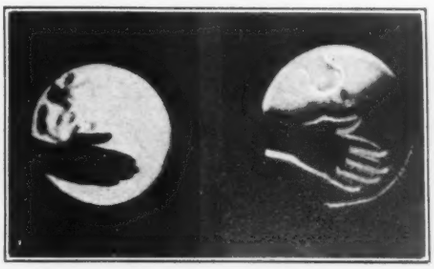
You Can See the Hot Air Rise from the Hand

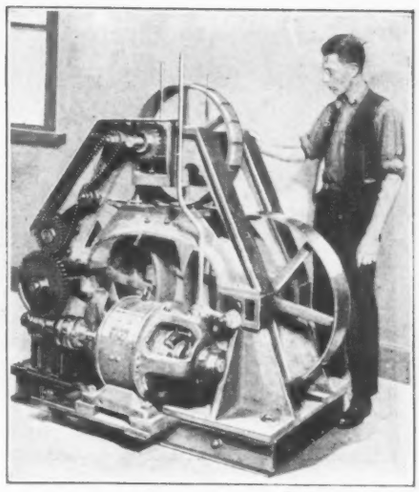
IN a dark room place a concave mirror upright and opposite it a bright light so screened that it shines only through a pinhole. The distance of the light from the mirror must be the center of the curvature radius, and the eye looking at the mirror must be close beside the source of light.

The mirror will appear evenly illuminated.

When an opaque object such as the straight edge of a knife is partially passed across the cone of rays at the exact spot previously occupied by the eye of the observer, the illuminated disk as seen from back of the knife's edge will appear slightly darkened. Now get some one to hold his hand about three inches from the mirror.

The different densities of the air caused by the heat rising from the hand will become plainly visible.





© Harris & Ewing

Testing Strips of Shoe-Leather

WILL they wear well? That's the first question you ask when you find a pair of shoes you like. All sole-leather looks very much alike, and it's hard to tell the good from the bad by the eye.

The government, however, has a new machine for testing it. Strips of various makes of leather are nailed to the face of a revolving wheel. Directly beneath the wheel there is a sanded belt. As the wheel revolves, the leather strips brush across the belt with the pressure of a man's step.

After such a test it is easy to tell which leather is best.

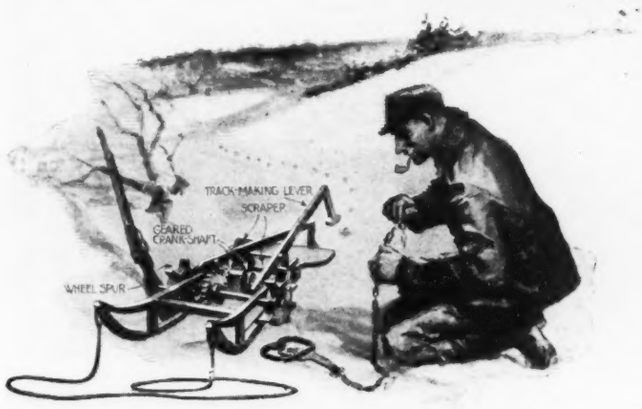
It is our opinion that many members of the leather trade have omitted this test.

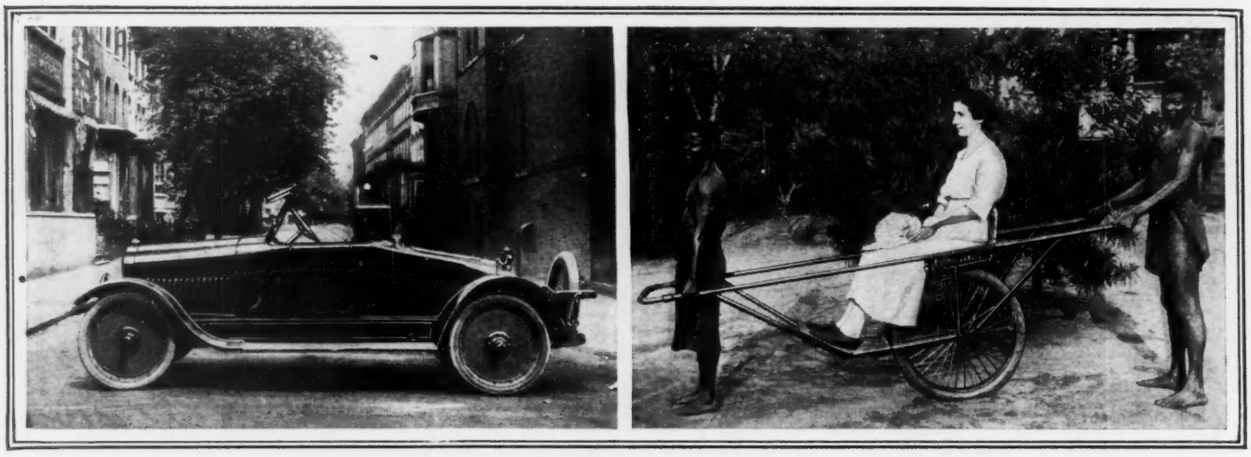
Bossy's Wearing Stockings Now

SHOULD a fly bite you, you would swat it. But when a fly bites a cow, she can't retaliate—she hasn't anything with which to swat it effectually. And so she kicks futilely, swishes her tail, and frequently knocks over the pail of milk.

Some lover of animals has thought out a way to save poor old Bossy such constant irritation.

This man tried fitting her with a pair of ladies' cotton stockings, size eight. They may not be a particularly good fit, because of the cow's peculiarly shaped leg, but at least they will foil the machinations of the flies. The idea originated in Illinois. If other cows in other states follow suit, specially shaped stockings may be made for them, and the hose industry receive a boost from an unexpected direction.





How Thieves Camouflage Stolen Cars

"STOLEN—a seven-passenger touring-car," is not an uncommon message at Police Headquarters.

When the police get a report like this, they watch out, naturally, for a large touring-car. But the thieves may have changed its shape in the meantime.

Take, for example, the automobile shown above. As you see, it is a roadster having two seats. Originally it was a seven-passenger car. The men who stole it removed the entire rear end of the body and substituted for it boards and canvas. Disk wheels added to the disguise. It was through a mere chance that the police found the car.

Such cases emphasize the importance of placing secret distinguishing marks for the better identification of your car on those parts of the automobile which the thieves in all likelihood will not, or cannot, remove.

Going Calling in "Darkest" Africa

"AFRICA" has a mysterious and terrible sound to most people. They think of it as populated with wild, unruly savages—a place where white men, and particularly white women, fear to tread. Yet the photograph reproduced above was taken there.

As you see, a white woman sits in a comfortable rubber-tired wheel chair propelled by two good-natured blacks. She is starting on a round of calls, and she appears to be perfectly satisfied with this means of travel. The chair is very ingeniously constructed to keep the center balance on its one wheel.

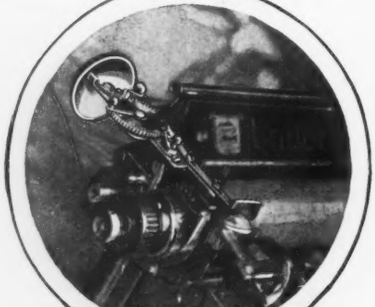
The house she lives in, which is shown in the background of the picture, is very modern; it was built on a firm brick foundation. Many American flat-dwellers might covet her comfortable home in the wilds of the "Dark Continent."

Dumping Hot Ashes from an Aerial Wire

AT the reduction plant of a California quicksilver mining company an air railway is being used for transporting red-hot calcines to the dump.

The rotary furnaces from which the calcines are discharged are in a parallel row and spaced about twenty-five feet apart. Each furnace discharges its calcines into a small hopper, from which they are emptied into a two-ton bucket. This bucket travels along the line of spouts, and receives the discharge from each hopper before traveling to the dump.

The tramway cable is supported by two wooden towers. It is eleven hundred feet long and travels at a height of one hundred feet. The bucket weighs nine hundred pounds and has a carrying capacity of four thousand pounds. It is dumped automatically by a tripper device.



It Warns of the Page's End

THE attachment invented by M. G. Navarre, shown in the accompanying picture, informs you that the last line of your typewritten page is reached.

It has a disk with fifty or more ratchet teeth. It is pivoted to a plate that is fastened to the machine. The disk has a movable indicator, bearing a small button. This may be set for any number of lines, single or double spacing.

Every time the line-shifter is operated, the lever engages the ratchets and turns as many spaces as are needed. When the required number of lines are written, the indicator will be in a position to signal the completion of the line by a warning bell signal similar to that of the line indicator.

Squeezing Out the Last Drop

MUCH has been said and written of the need of thrift and economy in every phase of the trivial round and common task. Above is given yet another instance of getting the most out of everything—even of a twisted, tortured old tube of tooth-paste.

In order to squeeze every bit of tooth-paste out of a tube, you must do two things.

First, be very sure to screw on the top each time after you use it. This prevents the paste from becoming hard and unsqueezable.

When you have reached the bottom of the tube, take a small glass bottle and roll it over the flattened tube. The last few drops can then be squeezed out—much as you would flatten out dough.

Popular Science Monthly

A Drill that Rivals a Shell

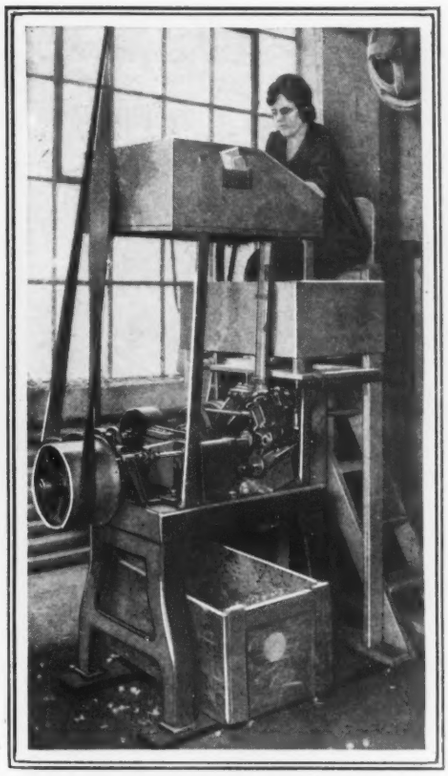
WHEN a fourteen-inch shell screeches its way through the air, men stand aghast as it crashes into armor-plate, burying its nose in the fracture. When a super-hard steel drill, revolving at five hundred revolutions a minute, plunges through armor-plate, a keen interest is awakened in the observers.

A milled high-speed drill has broken all records by the speed with which it can penetrate metal. Making six hundred revolutions a minute, it bores through tough machinery steel at the astonishing rate of thirty inches a minute. Making seven hundred and fifty revolutions a minute, it plunges through seventy-two inches of cast-iron, while it can travel through 9.2 inches of hard armor-plate in one minute, making two hundred and thirty revolutions.

Waste Paper for Packing

"DO not waste the waste paper!" should be posted everywhere. Not only can it be made over again into new paper, but it can be used as packing material. For this purpose there are special stripping machines which cut the paper into small strips. These are dumped into a "baler" and pressed.

There are several types of machines used for cutting paper. One is suitable for an office and is driven by a 1.5-horsepower motor. Twelve thicknesses of paper can be cut through by some of these waste-paper machines.



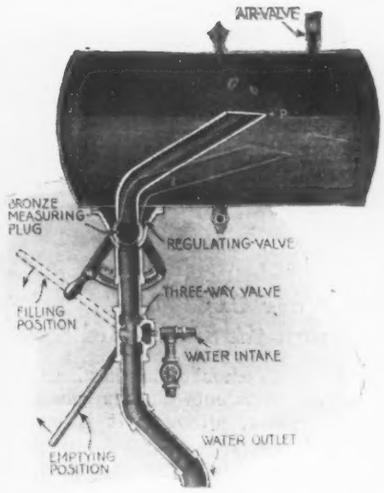
Dropping Caps Down a Tube to a Threading Machine

FEEDING screw caps to a threading machine—that's what the girl in the picture is doing. One by one, she picks them out of the bin in front of her, and drops them down a small tube at the side of the bin. When they reach the bottom they are grasped by the revolving machine chuck.

This machine rolls threads on shells, even when the neck is as small as one half inch in diameter and the flange as large as three inches.

This method of feeding means absolute safety for the operator. She sits on a platform at the side of the machine and is well out of its way. She climbs to her post by way of a short flight of steps.

Any device that makes for safety for factory workers is bound to reflect in added production. However, it is not always easy to convince factory managers or owners of this fact, and so there are constantly being added to the statutes of the various states laws for the protection of the workers.



It Measures Water for Concrete

AN automatic water-measuring device has been invented to enable the concrete-worker to gage the amount of water required for the various grades of aggregate.

With weather conditions known and a known quality of aggregate, a fixed supply of water is required. This can be regulated by the automatic tank.

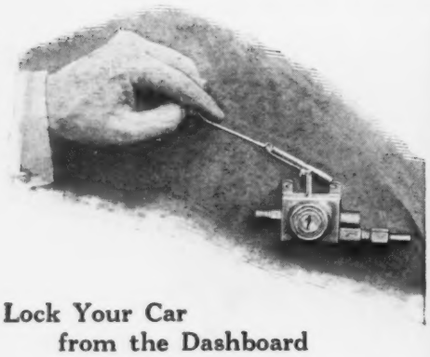
The tank is filled from the water supply for each batch of concrete. It is fed into the tank through the bottom after passing through a three-way valve. When the handle of the valve is set to the emptying position the inflow of water is automatically stopped. The outflow is controlled by the regulating valve set to give any desired amount of water. This valve consists of a spherical housing in which is set a bronze plug to which is attached a short pipe.

For Honest Scales

EVERY few years the public finds it is being cheated, and a campaign is started for honest scales. In Denver a campaign is now being carried on.

Mrs. Jones buys a pound of meat. She then takes it to an "official free city scales" booth, and has it weighed. If it is not an exact pound, she receives a certificate, which she takes back to the butcher, demanding her money's worth.

Duplicate certificates are kept by the official weighers. If several bear the name of any one merchant, the city inspector visits him.



Lock Your Car from the Dashboard

A NEW automobile lock has been introduced that cuts off the gasoline at the carburetor, although it is operated by a button on the dashboard. When you wish to lock your car, you pull out the button just as, in some cars, you pull out the ignition button to shut off your engine. If you lock it at night in the garage, you will prevent possible gas leaks and fire.

The button is attached to a cord connected with a latch on the lock. When the cord is pulled, the latch is turned and the lock locked. When you wish to start your car, you lift up the hood and use a key to release the lock.

The operation is so simple that in a short time it becomes second nature.

Bracing the Riveter

BELOW is pictured a compressed-air tool that is a great help to the riveter. It is nothing more nor less than a piston and a cylinder.

It is put in place in a boiler as shown, and air is allowed to enter the cylinder. This forces the piston out, and the tool then acts as a brace inside the boiler. It also holds the rivet in place while the workman on the outside of the boiler uses the riveting hammer on it.

All strains are taken off the boiler in this way. Otherwise the hammer on the outside would be apt to knock the boiler out of true.

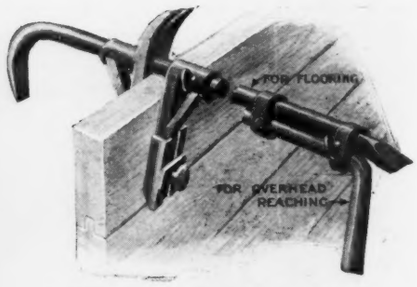
Such a pneumatic brace will find many other uses about the large shop. For instance, it may be used in forcing pieces in place instead of using a hammer. It is a handy tool for applying pressure wherever needed. A small compressor will supply the tool with sufficient air.

It Blows Wherever It Goes

THIS is a wandering blower. It is ready for duty at all times in any part of the factory or garage. It is necessary only to push it to the place where it is needed and connect it to the electric circuit. A steady flow of high-pressure air is available, which may be used for a multitude of purposes.

Keeping the delicate machinery and electric motors of the factory free from dust is only one of the important uses of this new outfit. It will deliver six cubic feet of air a minute under a pressure of two hundred pounds to the square inch. This is sufficient to inflate the largest automobile tires.

An attachment may be used with the blower that will spray gasoline on machinery to clean it of accumulations of grease and dirt.



A Tool for Wrecking Walls and Ceilings

IF one desires to remove the walls and ceiling of a house, here is a tool, invented by Edward F. Wilkinson, of Gramercy, Louisiana, that will do away with the bother of erecting a scaffold.

The iron bar is sufficiently long to reach to the ceiling of the average room. It is particularly adaptable to the removal of tongue-and-groove boards. After the nails have been extracted by the claw, the first board is pried out by the chisel edge. The shank is pressed down through the open space and the feet of the device are engaged with the next board, the lower foot beneath, and the upper foot above the board.

A lever movement is exerted, which has the effect of lifting the board out of its place in the ceiling or the wall.

Drilling Made Safe

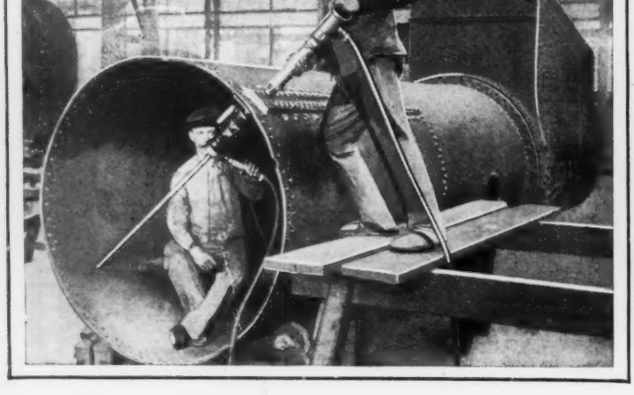
WHEN using compressed air or electric drills of the larger size in drilling and tapping out boiler-plate, workmen are sometimes injured if the drill or tap happens to break or catch in the work. Sometimes the drill pulls itself out of the workman's hands and whirls about with terrific force.

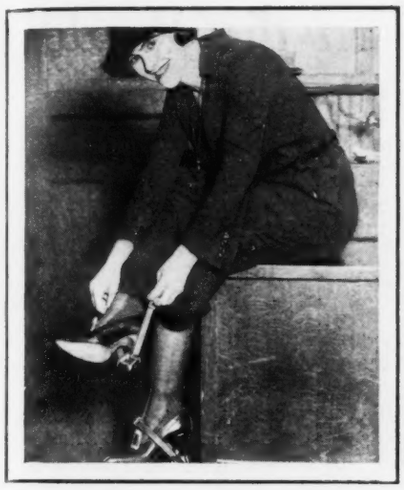
To prevent this, the little guide shown below is brought into use. This is placed into a hole in the boiler and the handle of the drill is slipped in place.

The drill is free to move backward or forward, but it cannot turn around. The guide also helps to keep the drill moving in a straight line.

The same device can be used in connection with high-power electric drills, since accidents are liable to happen with these as well as with the compressed-air drills.

This is a solution of a problem that has cost thousands of lives.





She Isn't Afraid of Slipping

SOME morning in midwinter, when you look out of a window of your comfortable steam-heated room and see the trees glistening in the sunshine, you exclaim: "Isn't nature wonderful!"

An hour later, though, you discover that the north wind that made the world so beautiful has converted the sidewalks into a skating-rink, and walking becomes uncomfortable and dangerous.

The young woman in the picture above is not afraid of the iciest pavements, now that she has a pair of ice-spikes for her heels. These spikes are attached to the heels by straps, and their sharp prongs bite into the ice with every step.

Making 360 Loaves an Hour

HOW long would it take a baker to roll the dough and shape 360 loaves of bread, or how many bakers would it take to make this number of loaves in one hour? Here is a machine that, with scant human aid, can mold sixty loaves a minute!

At the rate of a loaf a second, this mechanical "dough-molder" turns out the bread ready to be sent to the ovens and baked. It is a device that not only saves labor, but simplifies it, working with precision and speed.

Even so, working eight hours a day, seven days a week, more than six hundred of these machines would be required to prepare one loaf of bread a day for each of the inhabitants of Manhattan.

This Girl Pedaled Almost Across the English Channel

CROSSING the English Channel by airplane has become very popular, chiefly because of the unpleasantness of the rough trip by boat. Yet here is a young girl who calmly decided to pedal her way across.

Her bicycle is mounted on a pair of cylindrical pontoons, and the rear wheel is equipped with small paddles instead of a tire. These paddles make the bicycle-ship move when the pedals are worked.

Miss Hill, the captain of the ship, made a good start, and she was within three miles of the English coast when the waves became too much for her. Her ship overturned and she had to continue her journey in a boat.

We congratulate this daring young woman on achieving that much of her journey, and we should like to inquire whether she felt any tendency toward seasickness. Perhaps in the excitement of this unusual crossing she forgot the Channel's reputation in this direction.

The picture above shows Miss Hill snatching a hasty lunch on her way across.

© Kadel & Herbert

A Bicycle Side-Car for Baby

OF course, side-cars are not new, but they have not been used extensively in connection with bicycles. This man thought it would be practical to make one for his baby girl. He produced the substantial attachment shown.

The car itself is suspended on springs, which make it very comfortable to ride in. The frame is made with standard pipe and fittings. The wheel used is similar to the front wheel of a bicycle. A celluloid windshield and a small leather top, to keep out the sun and rain, complete the outfit.

It's nice for baby, and not too hard on dad.

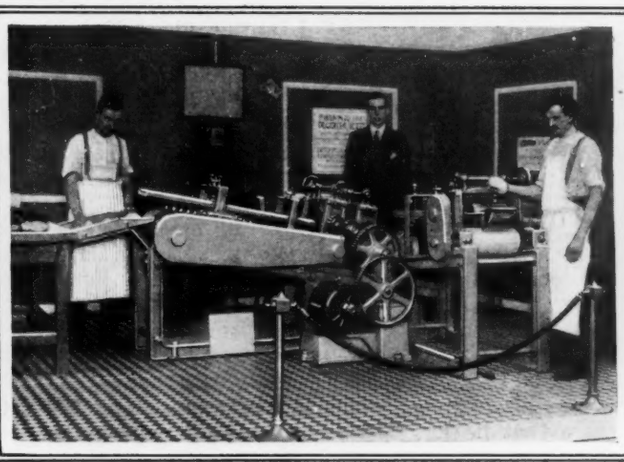
Ringing the Duck

IT does not seem so difficult to toss a light ring over a duck's neck, but try it and see! In Germany this has developed into a sport, "ringing the duck."

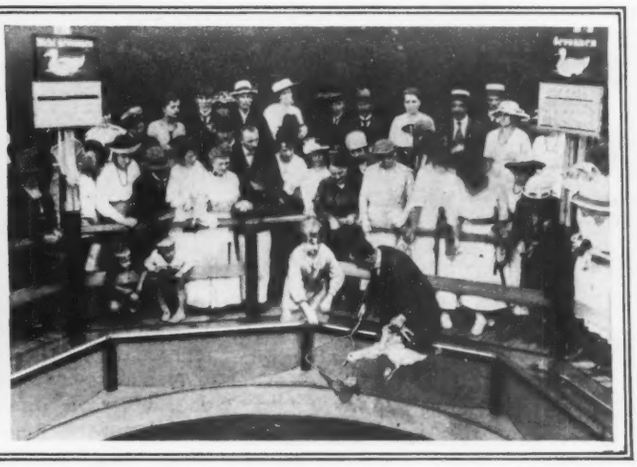
For five marks a player has three chances to throw the ring over the duck's head. If he wins, he gets the duck. This game is less inhumane than that of "wringing the goose," considered a legitimate sport by some. The goose is hung by its feet while horsemen ride swiftly by, trying to pull off its head. As the bird's neck is greased, it undergoes considerable torture before the neck-wringing is accomplished.

In the case of the duck no such inhumane treatment is practised.

© Keystone View Company



© Kadel & Herbert



Speeding Up Traffic on the World's Busiest Corner

How Dr. Harriss modified the railway block-signal system and applied it to Fifth avenue

By Herbert Asbury *and* Joseph Brinker

Dr. John A. Harriss, New York's millionaire Special Deputy for Traffic, who has spent many years in a study of New York's peculiar traffic problems, and who installed the present block traffic system on Fifth avenue at a personal expense of twenty thousand dollars

THE traffic problems of New York city, perhaps the most difficult and complex of any city in the world, and assuredly of any city in the United States, are not solved by a group of heavy-browed experts gathered in solemn conference around piles of maps and charts and blueprints. They are solved by one man—a tall, broad-shouldered, keen-eyed man who stands hour after hour, looking out of a window of his office upon the maelstrom of vehicles and pedestrians that is Forty-second street and Fifth avenue, thinking traffic and seeing nothing but traffic until suddenly an idea leaps full-fledged into his brain, and then, presto! — new traffic rules are promulgated and New York city takes one more step toward the traffic millennium when there will be no accidents and when motor vehicles and pedestrians will move east and west and north and south in perfect peace and harmony.

New York's Special Traffic Deputy

This man is Dr. John A. Harriss, Special Deputy Police Commissioner for Traffic. It is a big job with a big title, but for the long hours he puts in and the hard work he does Dr. Harriss receives probably the smallest pay of any man in the world. He receives exactly nothing—or even less than that, because, being an extremely wealthy man, he never asks the city to pay for putting his new traffic ideas into effect until he is certain that they will be successful. He pays out of his own pocket whatever expenses are incurred in giving them a thorough test, and then, if they justify it in the opinion of the Police Commissioner and the other city officials, the municipal authorities take hold and continue the schemes. The most that Dr. Harriss ever gets out of his work is a letter of thanks from his boss — that and the knowledge that he has contributed to the safety and the happiness of some millions of his fellow citizens. And that in itself, of course, is no mean reward.

Between five and six o'clock in the evening approximately 4500 vehicles pass the corner of Fifth avenue and Forty-second street. If the vehicles going in both directions were evenly divided, it would mean that 2250 vehicles would go north and 2250 vehicles south on Fifth avenue within the hour. Expressed in minutes instead of hours, thirty-seven vehicles pass the corner traveling north every minute and an equal number traveling south. Since Fifth avenue is wide enough for only three lines of traffic in each direction simultaneously, thirteen vehicles, three abreast, thirty-seven or thirty-nine in all, pass the corner every minute in each direction.

Fifth Avenue in a Rush Hour

Try to form a mental picture of thirty-seven vehicles passing the corner every minute going north and thirty-seven more going south simultaneously. Then consider that there are almost half as many vehicles waiting to cross this heavy stream of traffic in order to get from one side of Fifth avenue to the other, and the traffic jam becomes more realistic. Consider, too, the thousands of pedestrians waiting to cross from one corner to the other. Mix these up with the north- and south-bound vehicles and those bound east and west, and you have some idea of conditions at the most congested vehicular corner in the world. Picture also the pedestrians trying to worm their way through the streams of vehicles, some of them the costliest of limousines, moving ahead less than a foot apart, and you get a still better picture of the traffic jam that used to occur every night at that famous corner. We say "used to occur," for this condition has been entirely changed.

Many of us remember the curious little platforms surmounted by lamp-posts—safety isles, they were called—that used to dot Fifth avenue at various corners from Forty-second street north. It was Dr. Harriss who investigated and found that a great many accidents were caused by the safety isles becoming overcrowded with pedestrians, some of whom were pushed

off into the paths of automobiles. He abolished them, had them destroyed, and the records of the Police Department immediately showed a decided reduction in the number of traffic accidents on those corners. Dr. Harriss made radical changes all over the city, making one-way streets out of such an important artery of travel as Central Park West, which showed an unusually high percentage of the city's accidents—and traffic conditions once again showed an improvement.

Many schemes were tried out in an effort to speed up Fifth avenue traffic, but they all failed because the underlying principle was wrong. There was no uniformity of travel above or below the congested corner.

The Traffic Was Chaotic

At Forty-second street the traffic might be proceeding north and south while at Forty-third street it might be proceeding east and west, with the result that the vehicles passing Forty-second street going north had to come to a stop to permit the east-and-west travel at Forty-third street. This, of course, slowed up traffic, and when the same thing occurred at ten or fifteen other corners along the twenty-three blocks from the congested area between Thirty-fourth street and Fifty-seventh street, it created such a traffic muddle that the authorities in charge became alarmed.

During one test period it was found that it actually took one vehicle forty minutes to pass from Fifty-seventh street to Thirty-fourth street, a distance of slightly more than a mile. This was at a rate of less than two miles an hour!

The next step in the plan was a proposal for one-way traffic going south on Fifth avenue from ten o'clock in the morning until five o'clock at night, with all northbound traffic shifted to Park avenue, two blocks farther east, during the same period. This plan included tower signals erected along Fifth avenue to assist in the traffic movement.

Although this one-way traffic plan was never actually put into effect because it was shown to cause more instead of less confusion on such an important thoroughfare, the towers erected were retained and employed in the present plan of two-way traffic, which has reduced the running time between Fifty-seventh street and Thirty-fourth street from forty minutes to less than ten minutes, or more than seventy-five per cent, and, in the bargain, has permitted from twenty-five to fifty per cent more vehicles to use Fifth avenue with less congestion than ever before!

© Underwood & Underwood

What the towerman sees from his box overlooking Fifth avenue. Probably more individuals pass his house in a day than many persons see in a lifetime

What the Towers Have Done

The secret of this wonderful achievement is that the towers have made it possible for all vehicles going north or south on Fifth avenue within the congested zone to move at the same time and to stop at the same time to permit the crossing of traffic on all the intermediate streets between Thirty-fourth street and Fifty-seventh street.

In other words, traffic on Fifth avenue is now practically continuous in movement, except during stated intervals, when it is interrupted to permit cross traffic on the intermediate streets. No longer is traffic moving north and south on Fifth avenue at Forty-second street and east and west at Forty-first street. It is moving north and south across all side streets at once, and across Fifth avenue at all side streets at other intervals. Vehicles move between one tower and the next in much the same manner as trains controlled by the block system of the railroads, except that when north-and-south travel is stopped, the vehicles must halt at the nearest street intersection, no matter whether it is at the tower or not.

It is just this continuity of travel that has speeded up traffic and made Fifth avenue the fastest congested street to travel on in the world.

The traffic on the cross streets is guided entirely by the movement of vehicles on the avenue, resulting in a slight delay in starting. Here is a suggestion for installing signal lights in view of the vehicles on side streets

How the Signals Work

It is the block-signal-tower idea that has been responsible for the successful working out of the principle in practice. Each tower consists of a small boxlike house set up on steel stilts, with the floor of the house twelve feet from the roadway so as to give its occupant a clear view of the roadway from one

tower to the next. Besides a fixed white light that is used as a position light when there is no traffic regulation—for instance, in the middle of the night—there are two sets of three other lights on each tower, one set facing north and the other set south.

Each set of lights consists of an amber-colored lamp, flanked on one side by a green lamp of the same size and on the other by a red lamp.

When the amber lamp is lighted, it is a signal for traffic to move north and south along Fifth avenue, with east-and-west traffic in the side streets at a standstill. When the green lamp is lighted, it indicates that the north-and-south traffic is to stop to permit the vehicles in the side streets to cross Fifth avenue. The red lamp is used in order to flash a warning signal that the direction of traffic is about to be changed from the north-and-south to the east-and-west direction, or *vice versa*.

The red signal is always shown between the amber and green signals, and indicates that the vehicles in motion at the time must stop to permit traffic to resume at right angles to the line then moving. The time interval between the flashing of the red signal and the amber or green one following it permits the street intersections to be cleared, so that there is no delay in changing the direction of travel as soon as the signal is flashed. This is the theory of the system of continuous traffic.

One Man Controls All Signals

There are five signal towers, one at Thirty-fourth street and one at Fifty-seventh street, with three intermediate towers at Thirty-eighth, Forty-second, and Fiftieth streets. The tower at Thirty-eighth street is not used as a block or stopping-point, but is required to flash the signals between the tower at Forty-second street and that at Thirty-fourth street because the street level at the latter street is much lower than that at Forty-second street.

The flashing of the signals at all the towers is controlled by one man in the tower at Forty-second street. He employs an electric push-button bell system to notify the men in the other towers that he is about to change signals. This ringing of the bell gives the operator in each tower a sufficient interval of time to enable him to change the signals on his own tower simultaneously with the other operators.

All the towers are connected by telephone in case the bell system should get out of order.

Traffic Direction Is Scheduled

The signals are in operation from nine o'clock in the morning until midnight, and apply not only to vehicular traffic but to pedestrian crossings as well. The time allowed for north-and-south and east-and-west travel depends upon the time of day. From eight until ten o'clock in the morning, north-and-south traffic moves in periods of one and one half minutes, with east-and-west traffic at forty-second intervals. From ten in the morning until seven at night, the north-and-south interval is increased to two minutes, with the east-and-west period remaining at forty seconds. From seven in the evening until midnight, the north-and-south period is still two minutes, with the east-and-west interval reduced to thirty seconds. The red light to indicate a change of traffic direction is flashed for five seconds at all times.

While the traffic system is by no means perfect as yet, the great speeding up of traffic that it has made possible gives promise that it may be introduced on still other streets as New York's vehicular congestion becomes more and more serious. While it is difficult to estimate the saving effected in dollars and cents since the new system was installed, it is probable that the entire cost of the installation is saved every day it is in operation.

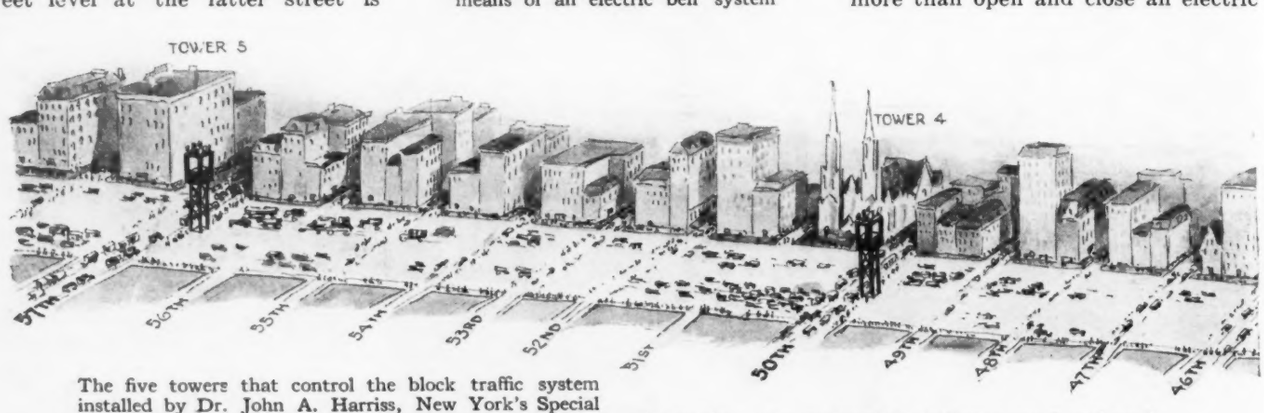
An average of 4500 vehicles an hour for ten hours a day means 45,000 vehicles using the avenue. If thirty minutes are saved each vehicle in moving from Thirty-fourth street to Fifty-seventh street, the total time saved is equivalent to 22,500 hours. Estimating the time of the occupants of the cars using the avenue at the low average of one dollar an hour, the system would save $22,500 a day or $6,750,000 for a 300-day year!

Suggestions for Improvement

Perhaps it may be possible to improve the system so that one man can operate all signals. By electrical controls, one man in one tower could change the signals on his own tower and the other four without the necessity of passing the word along to a man in each tower who does nothing more than open and close an electric

© Underwood & Underwood

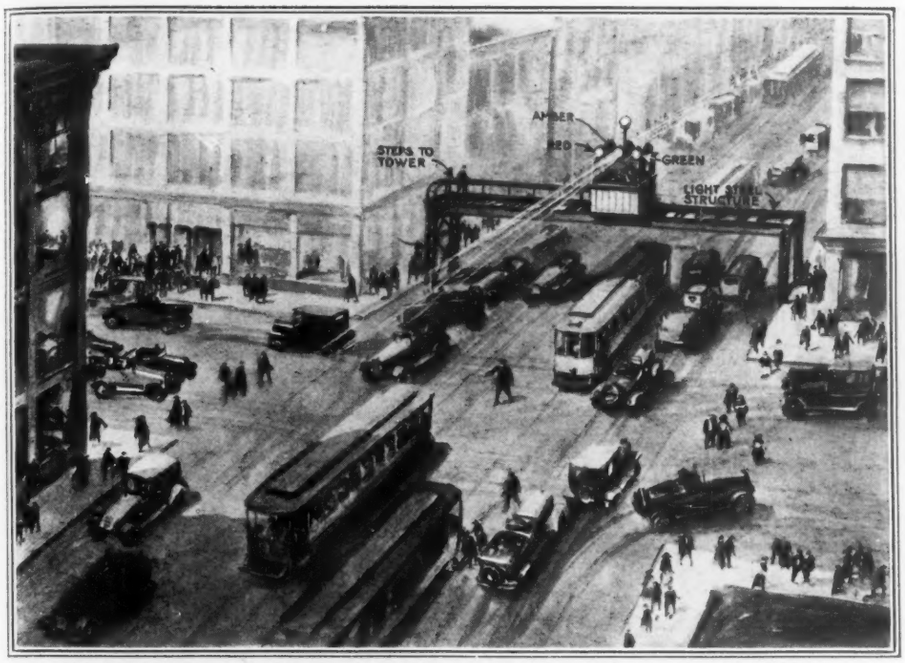
The master signalman in his tower at the corner of Fifth avenue and Forty-second street. He controls the lights in all the five towers, signaling the other towermen by means of an electric bell system



The five towers that control the block traffic system installed by Dr. John A. Harriss, New York's Special Deputy for Traffic. They extend from the shopping district to Central Park.

Each tower has two sets of lights, one facing north and the other south. Each set consists of an amber-colored lamp, flanked on one side by a green lamp and on the other side by a red lamp. These lamps flash their lights alternately. The amber light indicates north-and-south traffic, the green light indicates east-and-west traffic, and the red flash signals that the traffic direction is about to change and everything must stop for a few seconds. It has been estimated that the cost of installation of this system is saved every day it is in operation

Popular Science Monthly



Should the new traffic signal system be extended to streets on which there are street-cars, the tower might take the form of a bridge of light steel built over the street, with the towerman's box in the center

switch in accordance with the bell signals from the one controlling tower. It may also prove possible to install sets of three lights, amber, red, and green, as on the towers, on the opposite corners of buildings at each of the side-street intersections with Fifth avenue. At the present time the operators of vehicles waiting in the side streets to cross Fifth avenue cannot see the signals on the towers, and there is a slight delay in beginning traffic across the avenue unless a traffic officer is stationed at the street intersection.

Every One Must Help

The key-note of Dr. Harriss' campaign to make New York city's traffic the best handled in the world is cooperation between the pedestrian, the business man, the motorist, and the police. He says:

"For one man to attempt unaided to find the solution of a problem that presents so many factors, commercial, social, and municipal, would be manifestly impossible. The officials who have to do with traffic in New York must depend upon the cooperation of the police, automobile owners, chauffeurs, and owners of business establishments and places of amusement.

"The innovations that I have put into effect have been largely adaptations of well known principles of business efficiency. They provide for the elimination of needless waste of time, the recovery of lost motion, the prevention of friction, confusion, and misunderstanding. They should succeed because they take into account the spirit of sportsmanlike teamwork and the unfailing good nature which is typical of American crowds. And without the cooperation and sympathy of the people, rules and regulations are of scant avail."

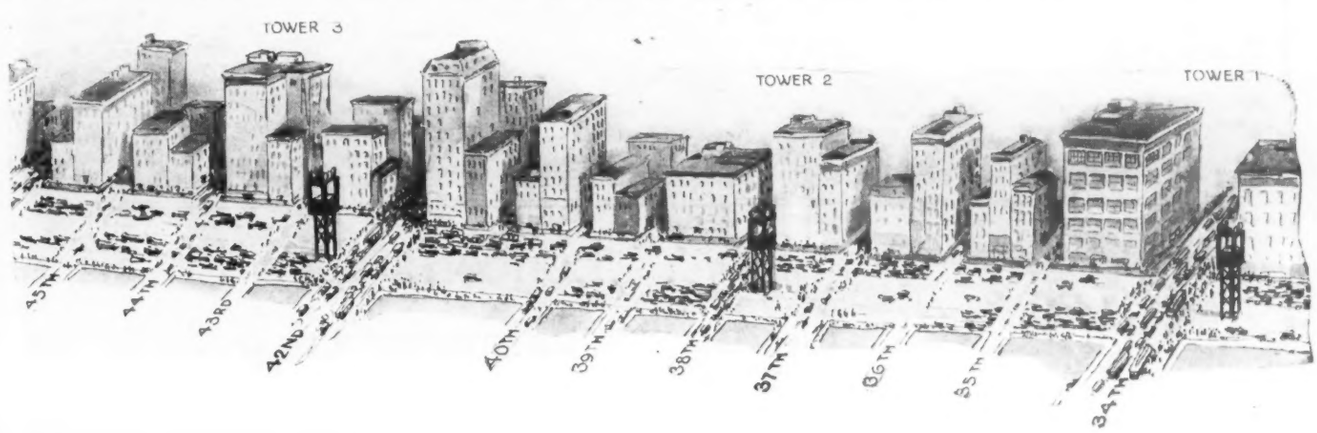
Dr. Harriss became interested in traffic regulation many years ago, when as a motorist he was continually coming in contact with laws that were supposed to control traffic but that in reality only made a bad matter worse, and entangled the problem in a maze of red tape and pompous official direction. He decided to learn all there was to learn about traffic, so he went to London and Paris and Rome and Berlin and Vienna, and for month after month he traveled and looked and listened and talked to traffic experts in the four corners of the earth—and then he came back to the United States to wait for a chance to put into execution some of his new-found ideas and knowledge.

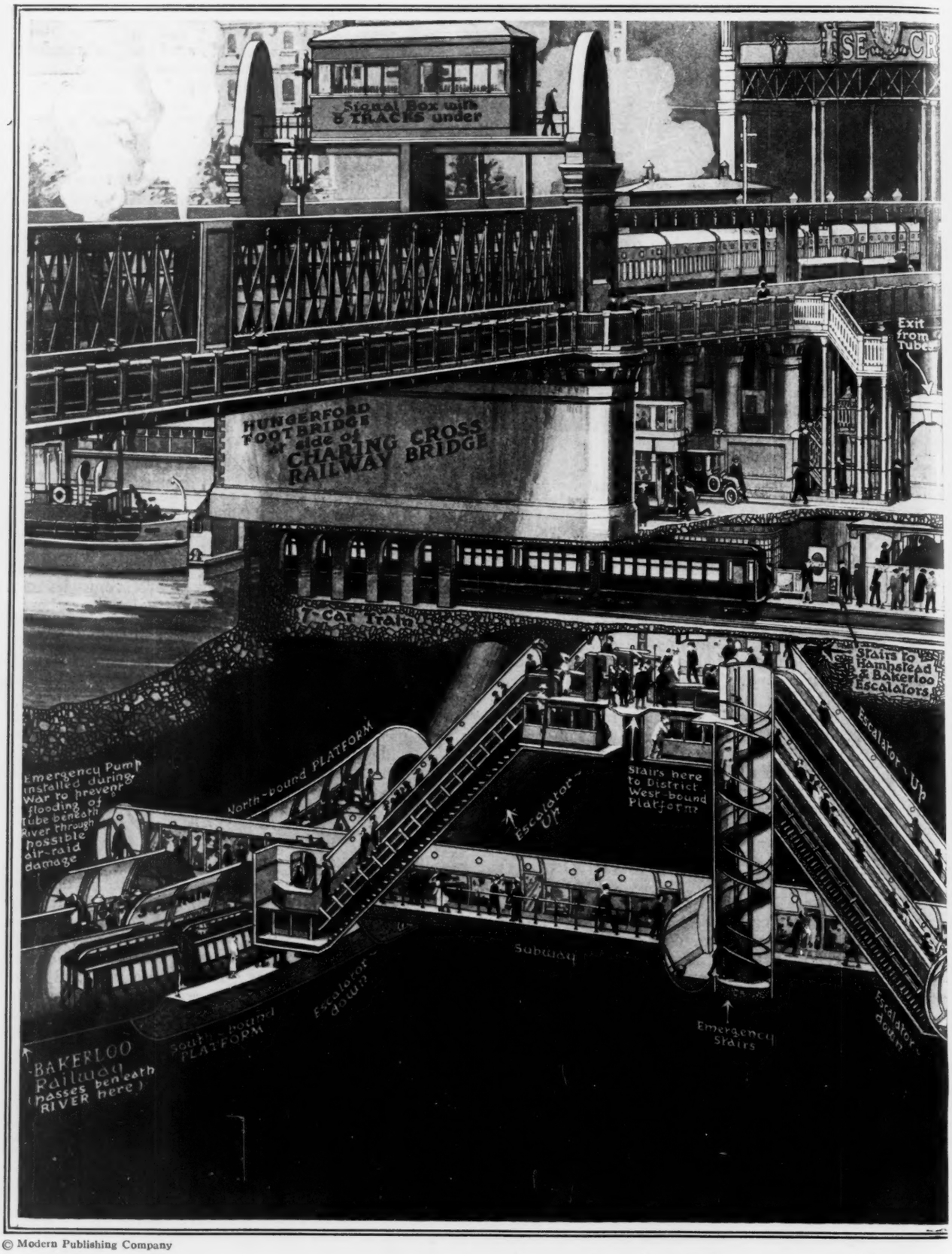
Dr. Harriss' Appointment

That chance came when Richard E. Enright, New York's Police Commissioner, made Dr. Harriss Special Deputy for Traffic, and it was not long after that event that motorists and pedestrians began to notice that the handling of the traffic in the metropolis, always the best in the United States, was becoming even better; the police were more efficient, there was more system to the work, and there was an all-around improvement that brought joy to every one who traveled in automobiles as well as those who had to jump out of their way several times during the day.

Dr. Harriss recently returned from a trip to Europe, where leading traffic experts in London and Paris listened with great attention to his latest ideas for making city street congestion less costly in lives and money. It is said that the London authorities are considering the installing of the Fifth avenue system in that most congested city in Europe.

With such a man as Dr. Harriss at the head of New York's traffic department, surely every citizen of the metropolis will not begrudge the little thought required to obey the rules as laid down by that department. As before stated, with the full cooperation of every man, woman, and child—the latter trained by the schools to observe traffic regulations—the problems and complexities of modern traffic without doubt would be considerably simplified.




Signal Box with 6 TRACKS under
SE & CR
Exit from Tube
HUNGERFORD FOOTBRIDGE at side of CHARING CROSS RAILWAY BRIDGE
7-Car Train
Stairs to Hampstead & Bakerloo Escalators
Escalator Up
Emergency Pump installed during War to prevent flooding of Tube beneath River through possible air-raid damage
North-bound PLATFORM
Escalator Up
Stairs here to District West-bound Platform
Subway
Escalator down
Escalator down
Emergency Stairs
BAKERLOO Railway (passes beneath RIVER here)
South-bound PLATFORM

© Modern Publishing Company

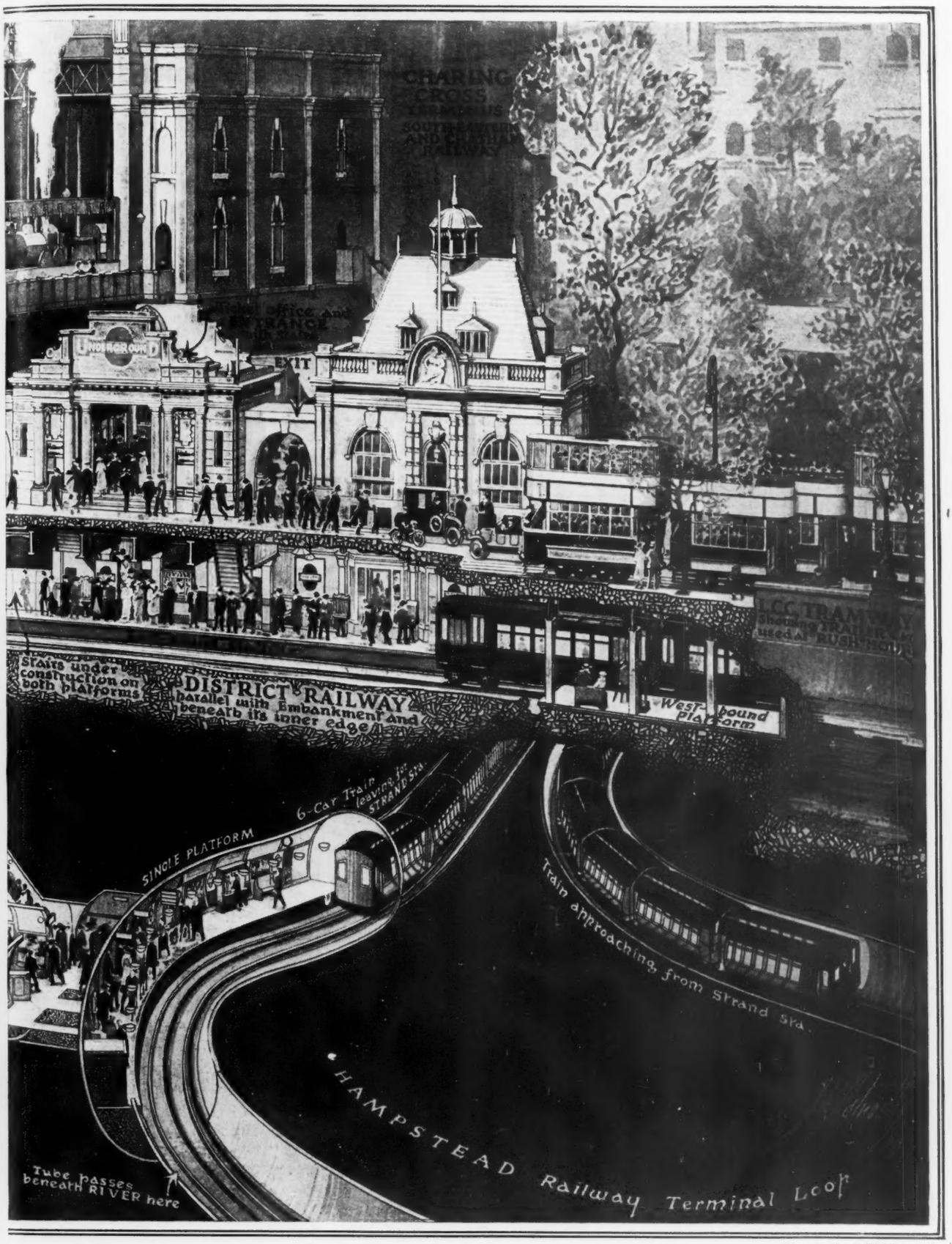
London's Five Levels of

Managing the public at one

CHARING CROSS station in London is one of the busiest spots in the world. It is the main junction of the underground railways, where 2290 trains stop daily. In one day 190,000 ordinary ticket-holders enter and leave the station, together with 32,000 season-ticket holders. The station carries traffic at five levels.

About twenty-five feet above the Victoria Embankment, Charing Cross railway bridge marks the location of the historic Hungerford suspension bridge, which it replaces, extending across the Thames. A double tramway track occupies the outer edge of the Embankment,

Popular Science Monthly



Drawing by S. W. Clatworthy

Traffic at Charing Cross

of the world's busiest corners

while seventeen feet below its inner edge are the electrified rails in the District Railway tunnel. Below this are the tube railways, the Hampstead platform being fifty feet below the east side of the bridge, while the Bakerloo platforms are sixty-three feet in depth on the west.

As indicated in the picture, a further stairway and short subway are being built from the street level to the top of the elevators to relieve congestion by separating ingoing and outgoing passengers at rush hours. At these periods the whole of the underground honeycomb is literally swarming with the masses of hurrying humanity

Measuring the Home-Brew Kick

Various methods of keeping within the eighteenth amendment

By John Walker Harrington

HOW high does the home brew kick? In these days, the citizen desiring to keep his elixir of malt and hops or his wine within the half per cent limit, can find simple devices by which he can know the amount of alcohol in fluids of his own bottling.

All methods for finding the strength of the brewed beverage are based upon the differences between the fermented and the unfermented liquids. When a cake of yeast is put into the wort or the kickless beer, it splits up the sugars and malt into alcohol and a gas quite the same as that which bubbles up through soda water and other soft drinks. Much of the gas escapes into the air, and the alcohol mingles with the water of the brew. As alcohol is lighter in weight than water, it follows that the beer is of a different density than it was before fermentation began.

For the purpose of finding out the relative or comparative densities of liquids, the hydrometer or "water measure" is used, and the instrument which is best suited for registering the home-brew kick is a type of this appliance. The common hydrometer consists of a glass bulb, drawn out at one end into a thin stem and at the other into a smaller bulb, which is weighted with quicksilver or fine shot. When it is put into a liquid, it bobs up and down for a few seconds, until it comes to an even balance. The weighted end holds it at rest, while on the scale placed within the hollow stem you may read numbered degrees, which show the difference between the liquid being tested and plain water. The result obtained is based on the fact that when a solid floats in a fluid, it shoves out of its way as much of that liquid as is equal to its own weight. Instruments of this kind are dropped into tall glass jars filled with the liquid to be examined, which naturally, as it is forced out of place by the floating weight, rises higher in the vessel. If they are put into a liquid heavier than water, they do not sink so deep. Every swimmer has noted that he floats more easily in the heavy briny waves of the ocean than he does in lighter fresh water. If the liquid is of lower density, more of it must be displaced before the weight of the instrument is supported, and it ceases to rise and fall.

This is the Balling saccharimeter, a carefully made instrument designed for the guidance of brewers. It shows how much alcohol is present by telling how much sugar has been lost in the brewing

The year 1921 finds home brewing among the favorite indoor sports. Our readers will be glad to learn how to eliminate the forbidden kick

If the home brew contained only alcohol and water, it could be quickly tested with the hydrometer here described. Many dealers in malt and hops and home-brewing supplies, who ought to know better, have been selling this instrument to their customers. It will give accurate readings, if carefully made, by which one can find out the strength of whatever whisky or brandy he may have saved as a relic of the dear, damp days beyond recall, since those fluids contain very little dissolved solid matter, because they have been distilled.

Beer and ale, as we have seen, are heavily loaded with sugar before their fermentation and after fermentation are still denser than the rill, on account of the malt and coloring matter and other substances which the water in them has taken up. Realizing that, the brewers make use of a specially constructed instrument, based on the principle of the hydrometer, but with a different scale, which tells how much alcohol is present, but in an indirect way. It is called a saccharimeter or, in other words, "sugar measurer."

No beer is properly made which still tastes of sugar, for as we have seen, sugar is converted into kick and bubbles. The saccharimeter tells us how much sugar has been lost and the rest of your problem is easy to solve.

In using the saccharimeter, pour the liquid to be tested into the glass jar which chemists call a graduate. Fill it within a short distance of the top, so that when you slip in the instrument, the liquid, when it rises, will be on a level with the lip or brim of the vessel.

Remove all bubbles before noting the stem figures. Wait until the saccharimeter is still. Make a record of your readings for comparison.

To calculate the amount of alcohol present, subtract the number of degrees shown for the second reading, that is that of the fermented beer, from the reading which you obtained from the wort or the unfermented fluid. Thus:

Wort	12
Beer	4
Difference	8

For rough estimates, divide this result by two; for more exact results take forty-five per cent of it. The strength of this brew in the specimen readings above would therefore be nearly 4 per cent in alcohol, or, to be more precise, 3.6 per cent, or about the same as brewers made before they descended first to 2.75 and then to one half per cent. Directions for making home brews prescribe that the extra kick be expelled by heating.

First-class saccharimeters have small thermometers also in their bulbs by which one may know the exact temperature of the liquids being tested, for there are slight differences in the readings for fluids, warm or cold.

Are You a Lawbreaker?

ONE half of one per cent. You know what that means. If you make your own wine at home, or brew your own beer, how can you tell whether it contains more than the permissible one half of one per cent alcohol?

In this article some simple instruments are described which will enable any householder to measure the alcohol in his home-made beverages.

The unfermented wort, of course, should be cool before it is investigated. Chemists allow for differences in temperature. In reading the thermometer, be sure to leave its bulb in the liquid, although it will be necessary to lift up the saccharimeter itself.

By observing closely the accompanying photographs, posed through the courtesy of the Schwarz laboratories, of New York city, you may soon become expert in its application.

Dr. Waldbott's Alcohol Test

Another simple test is that recently devised by Dr. Sigmund Waldbott, of the University of Cincinnati. He uses a small copper flask, which is connected with a cylinder containing glass beads placed above it, and from this cylinder is led a tube which is smaller at its outer end. Put the fermented liquid into the flask and apply heat. A Bunsen gas-burner is the best device for raising the temperature. The vapor driven off from the heated fluid goes up through the little bead-filled drum, and escapes through the tube. Dr. Waldbott says that if the fluid in the flask contains 3 per cent of alcohol, the escaping vapor will burn at the tip of the tube for three minutes in a flame three inches in length after it has been lighted. If the beer contains only one half per cent, the flame will be about the same length, but will last only twenty or thirty seconds.

Both brewers and Internal Revenue agents have in the past few months found the new type of ebullioscope or ebulliometer, invented by Dr. Juerst, a very satisfactory means of making rapid and reasonably accurate tests of near-beers.

This instrument is based upon the differences in the boiling-points of water and alcohol. If a liquid contains some alcohol, it will go into ebullition more quickly than plain water. Hence, the ebullition meter or the ebulliometer.

This long-named device, which is about sixteen inches in height, consists of a miniature metal boiler into which the fluid under our scrutiny is placed and then heated with the alcohol lamp underneath it. Denatured alcohol, of course. A delicate thermometer which is attached shows the exact temperature. The operator, however, must first boil pure water in the device, for as differences in the air make slight variations of the point at which water boils, there must be an up-to-the-minute water reading as a basis of comparison.

Although the Juerst instrument is not official, it is a great help to the brewer in keeping tabs on his processes. Though it is possible to brew a beer originally which contains less than one half of one per cent of alcohol, the brewmasters usually make the beer of 2.75 strength, and then drive the alcohol out of it by passing it over a heated metal surface.

Drinks with an Evil Tendency

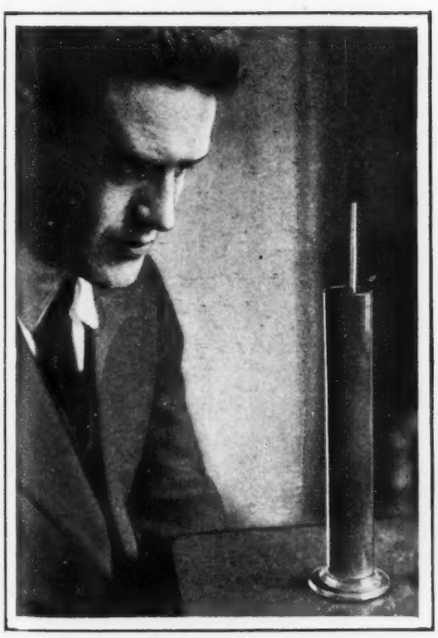
In this way, they can retain their old appliances, and as hope dies hard in the human breast, scores believe that some day they may be able to vend beer which is not devoid of a recoil.

This device is also used by makers of soft or temperance drinks, for even the most harmless fruit-juices, or mixtures containing a little sugar, are likely to go on their wayward path by getting a stiff nip. The Eighteenth Amendment has not nullified that great statute of Nature, the law of fermentation, and the temperance-drink vendor, as well as the brewer, is in terror of putting on the market a beverage which has more spirit than the Government permits. The brewer must sterilize his product with great care, lest before it is in circulation some vagrant yeast germ or a little excess sugar will have started the fermentation all over again. The Government chemists realize that even after the beer has left the brewery, some evil disposed person, desiring to injure the maker, may put yeast and sugar in the finished product. Hence the utmost vigilance at all stages of manufacture, and the frequent appeals to the ebulliometer or similar quickly responding devices.

Some More Complicated Tests

Valuable as are the emergency methods for rapid determinations of alcohol, both the Government and the brewers, in examinations where absolute accuracy is demanded, as when a question has been raised on a decimal basis, resort to the polariscope, the picnometer, and distillation appliances, with which the home brewer would not care to concern himself.

The householder has within his reach, however, means by which he can tell where he stands in his domestic brewing and therefore can find scant excuse for pleading ignorance of the strength of the potations made under his roof-tree.



How you should use the saccharimeter for home brews. The liquid is level with the edge of the jar and all foam has been removed. By showing the sugar lost, the alcohol content is proved

How to read the saccharimeter for temperature corrections. Be sure to keep the mercury bulb in the fluid if you are looking for an absolutely accurate reading

Grubbing Up Tree-Stumps with Liquid Oxygen

ON account of the scarcity of plastic explosives since the war, liquid oxygen has recently come into extensive use as an explosive. Liquid oxygen in itself, of course, is not an explosive; it must have a carrier in the form of a paper cartridge.

It is necessary to saturate this cartridge in the liquid oxygen for from twelve to fifteen minutes to make it effective. The fuse should be drawn through the cartridge before subjecting it to the soaking process. The small flame of the fuse is sufficient to convert the cartridge into carbonic acid and water vapor.

Some very promising tests of the use of liquid oxygen for grubbing up tree-stumps—and thereby recovering needed amounts of fuel—have recently been made in the Grunewald woods, near Berlin. A blast-hole about five feet wide was made in such a manner that the cartridge could be inserted below the rootstock of a giant oak. Next the liquid oxygen was poured into a "soaking" vessel and the cartridge thoroughly immersed. Finally the soaked cartridge was placed in the hole and covered with earth.

The grubbing up of this root, which required only two cartridges—absorbing sixteen hundred grams of liquid oxygen—strikingly illustrates the possibilities of this explosive, which many experts consider to be the explosive of the future.

Neither liquid air nor carbon cartridges are subject to the legal restrictions that apply to the storing and transportation of explosives. In fact, previous to the soaking process there is no explosive present. The cartridge inserted into the ground keeps its explosive character for only about twenty-five minutes, after which time all the oxygen required for a chemical reaction becomes vaporized. Electric ignition can, of course, also be used in this connection.

After an explosion an oak rootstock was reduced to these fragments, which were recovered for fuel

Pouring the liquid oxygen into the "soaking" vessel, preparatory to saturating the cartridge

A liquid-oxygen explosion. Liquid oxygen can be safely stored and transported

Apart from their use in forestry, in connection with clearing operations, road construction, and similar uses, these cartridges will probably find many uses in agriculture. In fact, their utility in all kinds of operations requiring power and rapid action will almost certainly bring them into wide use on American farms when their practicability has been brought to the attention of farmers in this country.

How Sections of Huge Pipe Are Bent

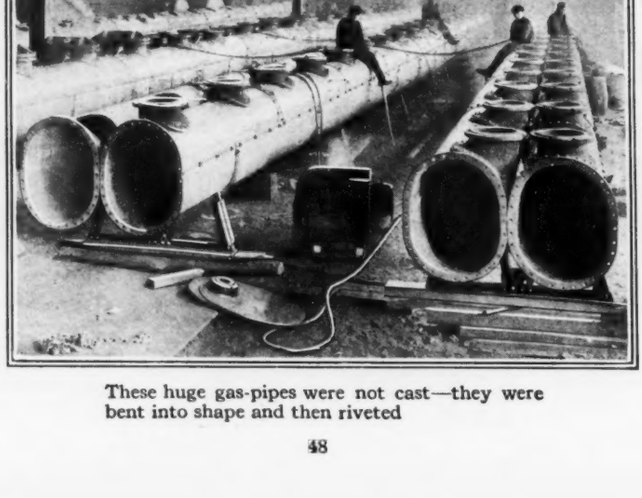
HUGE steel pipes are usually cast, but they can also be bent into shape.

Take, for example, the hydraulic gas-mains shown here. They were made from sections of flat steel plate. The sections were very thin—not any more than half an inch in thickness.

After being cut to the proper size and bent into shape, they were riveted together until they made a pipe that was one hundred feet long.

The outlets that will lead from the main pipes to auxiliary ones are castings, and they also were riveted to the main pipe. The necessary welding was done pneumatically and the long ropelike tubing used for the purpose is shown resting on the pipes. These tubes carry compressed air to the hammers, which force the rivets into position.

Each plate was bent into a semicircular shape, and then riveted to a similar plate to form a pipe. As the sections were added and the pipe lengthened, great care was taken to see that the upper and lower sections were not added at the same place. Thus the joints were all firm, and subsequent gas leakage was unlikely.



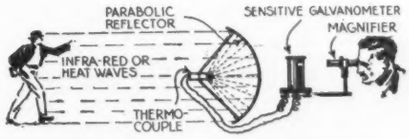
These huge gas-pipes were not cast—they were bent into shape and then riveted

Police frustrating a burglary by the use of the thermocouple, which detects heat waves given off by the human body at a distance of six hundred feet or more

Heat Waves Betray Burglars

THE human body radiates considerable heat. Heat waves are shot outward from it in all directions at terrific speed. An instrument has been perfected that collects and concentrates these heat waves and projects them on a "thermocouple." So sensitive is this new device that a human body can be detected with ease at a distance of six hundred feet or more.

A thermocouple is merely two dissimilar metal wires soldered together. When heat waves fall upon a thermocouple, a small current will be generated. The strength of this current will depend upon the intensity of the heat source. The thermocouple used on this apparatus is placed at the focal point of a parabolic reflector. When heat waves strike the reflector, they are concentrated and reflected on the thermocouple. Thus a small current is generated, and caused to pass through a sensitive electrical measuring instrument called a galvanometer, and in this way the slightest movement can be seen.



This shows how the heat radiations are received from a human body and reflected upon the thermocouple

A suggested use is here illustrated. A burglary is being frustrated. The sensitive part of the apparatus is so mounted that it can be turned in any direction. Armed with this, the police can "see" the approach of the burglars, though darkness hides them.

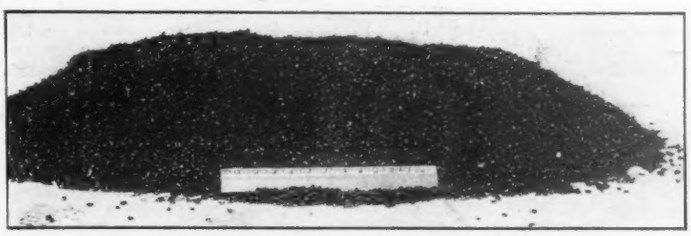
As a demonstration of sensitiveness, a man was placed in a hole several hundred feet from the thermocouple. While he was concealed, the galvanometer did not register. When he merely raised his head above the surface, the instrument registered instantly.

Getting Rid of the Japanese-Beetle Pest

IN the farmers' war on their enemies the Bureau of Entomology, United States Department of Agriculture, takes an active part. Its experts go out into the fields and analyze the soil, observe the birds, examine the insects, and work industriously to discover exactly what things are beneficial and what are detrimental to the agriculturists' interests.

Discoveries are frequently made and inventions devised to help eradicate the farm's destructive enemies. Thus it is that forty-eight quarts of beetles can be easily collected to demonstrate the efficiency of methods by which the raid was so well conducted.

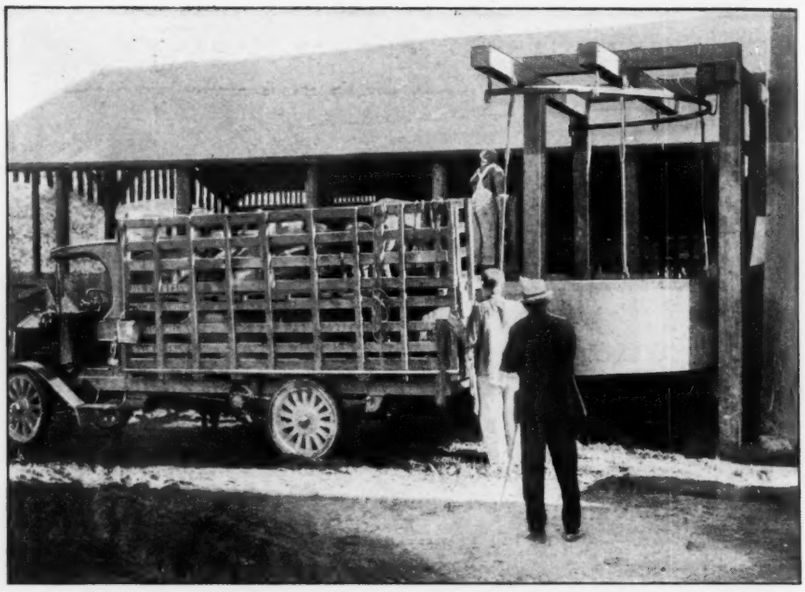
There are various ways of destroying these insects before they reach the "beetle" stage. Burning stubble and spraying with flames of gasoline, with mechanical methods for controlling the fire, are among the most effective.

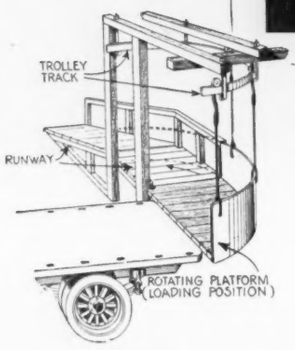


Forty-eight quarts of beetles, gathered in a fight on the pest being carried on by the United States Government

This foreign beetle that has made its appearance in New Jersey is known as the Japanese beetle. One way that has proved successful in fighting the pest is the application of that deadly poison, cyanide. The poison is dissolved in water and is applied to the soil, killing the grubs before they can grow up.

New and Better Ways of Loading Live Stock on the Motor-Truck

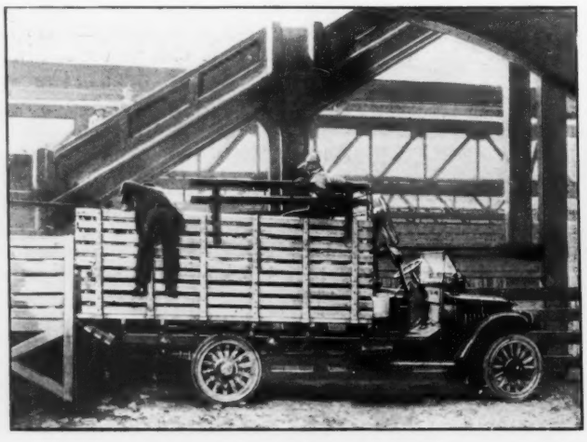


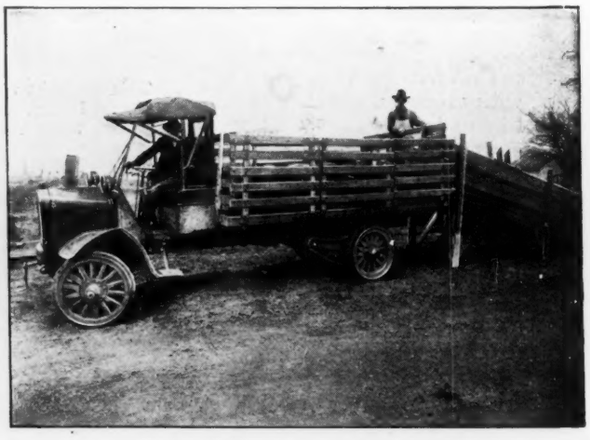


Unloading Sheep at the Cincinnati Stockyards

With the use of the motor-truck for transporting live stock have come many improvements in handling. At the Cincinnati stockyards sheep are unloaded by means of a horizontal chute pulled out from over a permanent inclined runway. The truck does not back up to the chute, but runs up parallel to it, after which the horizontal chute is pulled out directly back of the body.

This method avoids maneuvering on the part of the truck and damage to the rear of the truck or the front of the chute in careless backing up on the part of the driver



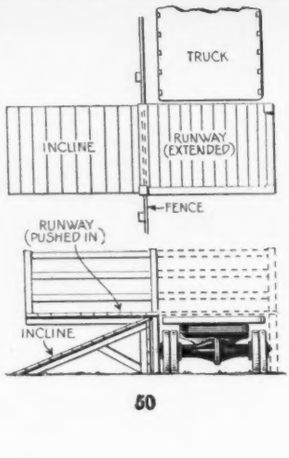


A Complicated Segmental Swing Chute

A somewhat complicated segmental swing chute that is swung around in back of the truck. The device is in use at the Cincinnati stockyards.

Notice, in the small line sketch shown near the top of the page, the ingeniously arranged trolley on which the curved metal chute swings. This type of chute eliminates the necessity for backing the truck into exact alinement with the edge of the chute.

At the right is a different type, in which the extended part of the chute is supported on legs

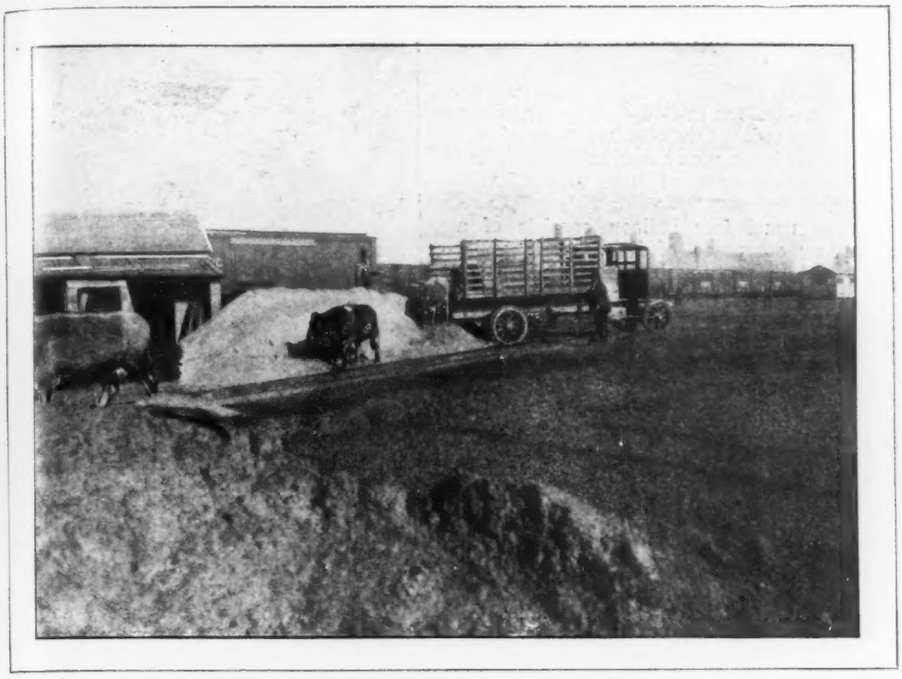


A Simple Portable Inclined Chute

By transporting his live stock by motor-truck the farmer does away with the necessity of waiting until he has a carload or of sharing with some neighbor the use of a car. While he is doing this, the price often falls before he can reach the market, resulting in a considerable money loss for which he is nowise to blame, but which he alone must bear. He must load his stock as carefully as it should be unloaded at the stockyard.

The picture above shows a simple portable inclined chute for loading hogs, sheep, and cattle

A Free Balloon that Hasn't



A Simple Expedient to Avoid Broken Legs

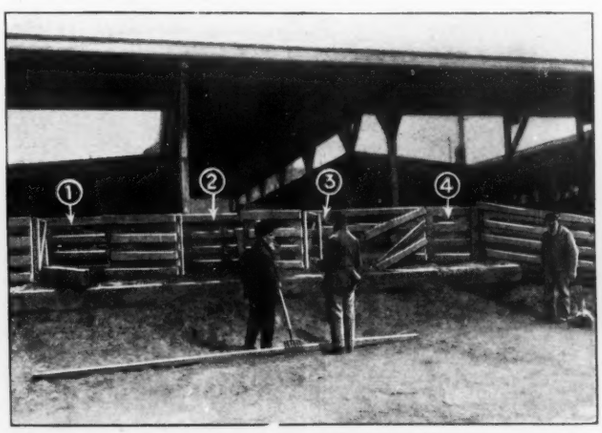
Although at some yards cows must still jump out of the truck bodies on to the ground, a distance of three or four feet, this practice has been abandoned at the more progressive yards because of the danger of broken legs. One Kansas City stock-raiser, aware of the danger of making his cows jump from the truck to the ground, backed up his truck to a sand-pile when about to unload, and the animals walked from truck to sand-pile easily and naturally. They were then driven on the hoof to the stockyards gate

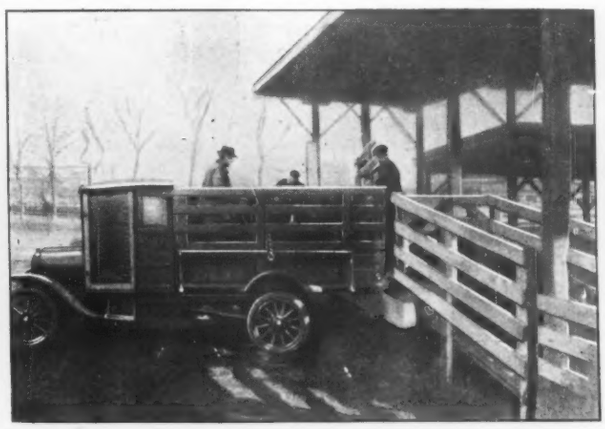
Why Motor-Trucks Are Supplanting Railroad Box-Cars

More than 1,500,000 live hogs, sheep, beef cattle, and calves were hauled from farms to near-by stockyards by means of motor-trucks in 1919. Because of the greater expedition of delivery by trucks as compared with railroad shipments, the truck is being used more and more in such work.

It has many advantages over the rail method. The farmer is able to get his live stock to market while the price is high. This is not possible by rail shipping, for the freight-car has to be ordered first, and this sometimes takes two or three days. Then again, the animals lose less in weight when transported to market in motor-trucks.

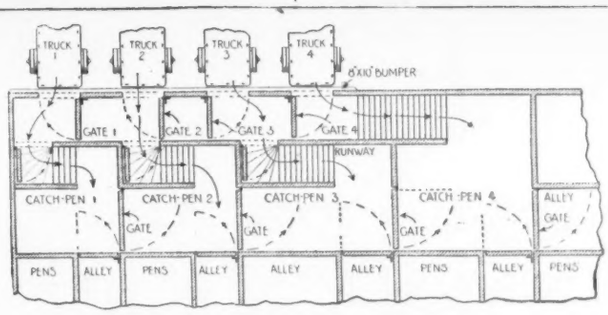
The motor-truck method has made necessary new methods in the stockyards, some of which are shown on these two pages.





Here Is the Best Plan

The longer a load of cattle must travel in railroad box-cars, the more weight the animals lose. This is caused by the discomfort suffered from jars and jerks whenever the freight-train stops to allow passenger-trains to fly by. For this loss the farmer must pay, since stock is bought by weight at the stockyards. This is another reason for the wide use of motor-trucks for hauling live stock. The platform shown above is perhaps the best of all the new unloading layouts

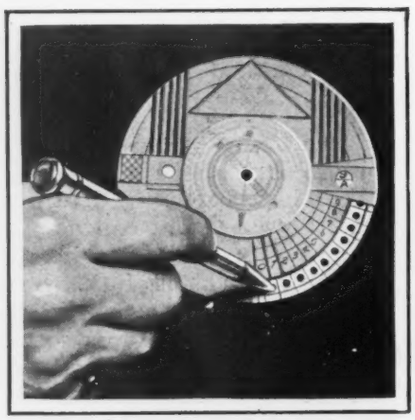


Showing the plan of the loading scheme in use at Omaha. By this arrangement four trucks can be unloaded at one time without getting in one another's way

2000 Hogs Daily

The Omaha plan permits four trucks to unload at a time, and has no moving parts to get out of order and no maintenance cost. The layout shown will permit two thousand hogs to be unloaded daily. Speed of unloading is an important factor to the truck-owner and to the stockyard. To the former it eliminates costly truck delays; to the latter it prevents vehicular congestion and overtime work in getting the animals into the pens, ready for sale

January, 1921



A Pocket Adding-Machine

THE Chinaman of the laundry counts his change on a rack of strung beads. The man behind the counter uses a cash-register. But here is a pocket adding and subtracting device that will enable any one to reckon the amount of figures in addition, division, or subtraction.

To add, he puts the point of his pencil into one of the holes that surround the lower of the two cardboard disks and rotates the disk toward the right. To subtract or divide, he rotates the disk toward the left.

The two disks are so arranged that they revolve easily upon one another over a series of numbers.

A Free Balloon that Hasn't Any Net

NEARLY two centuries ago the first free balloon drifted its way across the sky, yet today this obsolete type of aircraft still holds such a fascination that men continue the sport of "free balloon" voyages.

The usual free balloon consists of a gas-bag composed of light, airtight silk encased in a network of strong cords to which the basket is attached. But recently there has been invented a balloon that dispenses with the netting. Instead, the series of meridian and parallel sections—"trajectories," they are called—are sewed on the envelope and tightened by adhesive strips. Each third section ends in the summit of one of the "bolt-rope" arcs, which form a wreath around the lower part of the envelope.

The absence of network aids in replenishing the supply of gas. The car is more stable and repairs can be more easily made.

Although this is the day of airplanes and power-propelled dirigibles, there is a fascination in "free ballooning" that retains a number of enthusiastic followers. Helpless in the face of the wind, the free balloon drifts hundreds of miles in a course that varies with the currents of the air at different levels.

How to Strengthen Flower-Pots

LARGE pots of clay, used for palms and other big plants, are almost sure to crack in time, from the strain and weight of the earth. The cracks usually start at the top and gradually extend the length of the pot.

To prevent this, wrap a heavy copper wire tightly around the pot, under the shoulder. Cut the ends, leaving sufficient wire for the ends to be carried over the top of the pot and bent down inside to support the wire ring. One support is not enough, so a piece of wire should be inserted under the ring on the side of the pot opposite the first support. This should also be bent over the top of the pot.

The Tight-Fitting Overalls

"WHY should overalls be loose around the waist and feet?" inquired Elizabeth Maddex, of Terre Haute, Indiana. Whereupon she invented a new kind of overalls.

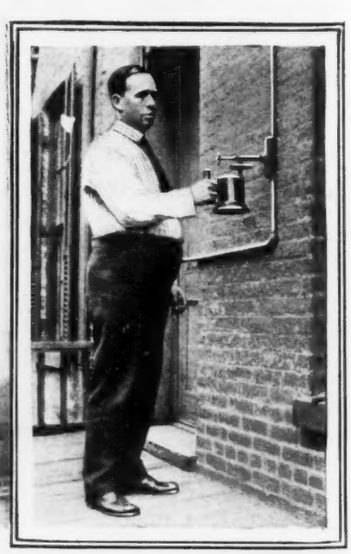
These overalls have a belt that may be loosened or tightened to suit each wearer. A pair of straps—one at the knee and one at the foot—are sewed into the seam of the trousers. They are joined together by a fastener that snaps over a button after the straps have been wound around the legs.

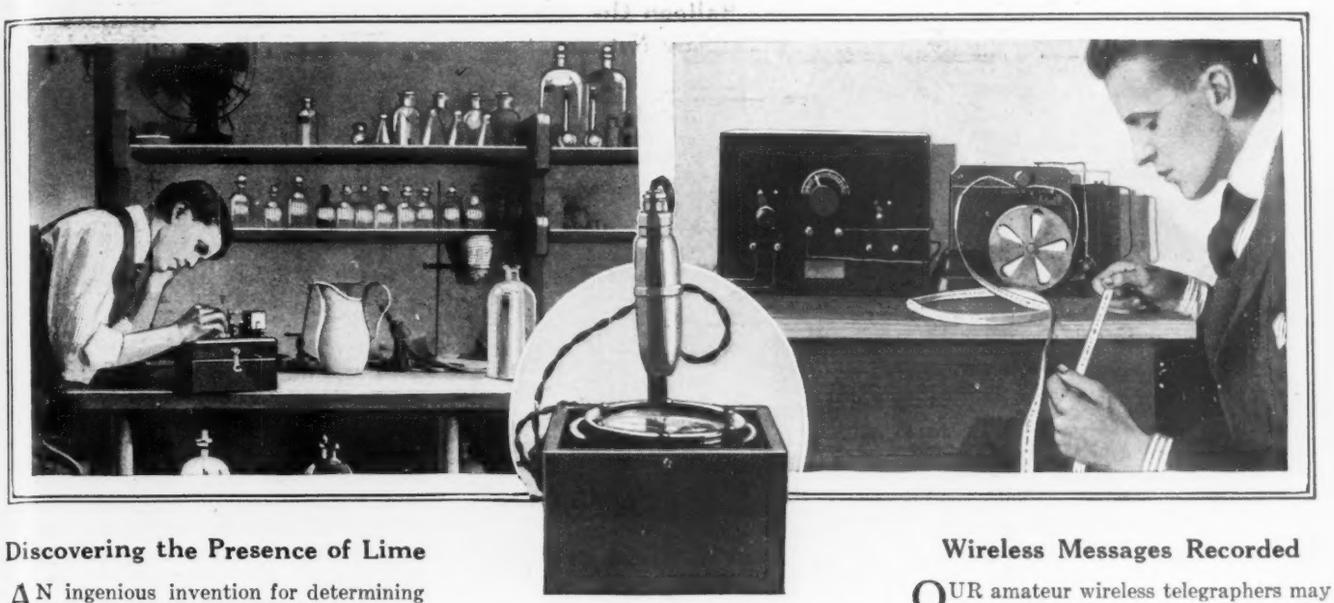
One look at the picture below shows the improvement that has been made in the humble overalls.

Thawing Pipes by Torch

A FEW days of zero weather, and you hear a good deal about "frozen pipes." The plumber comes with his blow-torch, and thaws them out inch by inch. Now, however, there is an attachment for the torch that enables the flame to concentrate on a large section of the pipe at a time.

It is a long tubular case, closed at both ends, that fits on the spout of the torch. A longitudinal section of the tube is cut away and the edges are notched to form teeth. These teeth grip the pipe, and the flame, extending the full length of the tube, spurts out through the notches and curls around the pipe.

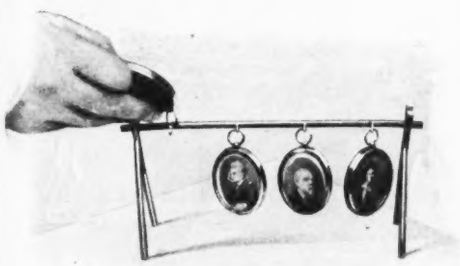




Discovering the Presence of Lime

AN ingenious invention for determining the amount of lime or other alkali in soils has been developed by the Bureau of Soils of the Department of Agriculture. The instrument, known as the electrolytic bridge, is really an improvised Wheatstone bridge.

By filling a small cup accompanying the bridge with soil saturated with water and determining the resistance by use of the bridge to the passage of an electric current through this amount of soil, the approximate percentage of soluble alkali may be determined. Thus the field men may rapidly determine in the field the amount of alkali present and indicate it on maps for that area of the country.



Family Portraits on a Rod

IF you think the family album does not give your ancestors' photographs sufficient display, you might try hanging them up on a pole in your parlor. That's what they're doing in England now.

Such an arrangement is shown above. The picture-frames have loops at the top which fit over hooks attached to a metal rod. The rod is supported at the ends by crossed bars.

When you grow tired of looking at your great-great-aunt's picture, you can take it off the hook and substitute some one else's face.

The rod, which is supported by two end pieces, is a small one, measuring about six inches in length. Of course this accommodates only very small pictures. Those shown above look like old miniatures. In the absence of such heirlooms as these, you might use your favorite snapshots.

Light for the Mariner

STEERING a vessel by compass at night taxes the eyesight severely. The pilot must have enough light to see the motions of the compass needle, yet must be able also to peer beyond in the darkness to catch the glimmer of a distant beacon.

The retina of the eye needs time to accommodate itself to changes in intensity from a bright light to darkness. Thus a light for the compass, the clock, or the tiller-ropes of a craft should be so designed that it will afford the greatest protection to the eye.

The light for compasses and clocks that is shown above saves the pilot's eyes by throwing its rays only upon the dial above which it is suspended.

One Man Can Operate This Ice-Cutting Machine

HERE is an ice-cutting machine that can be operated by one or two men.

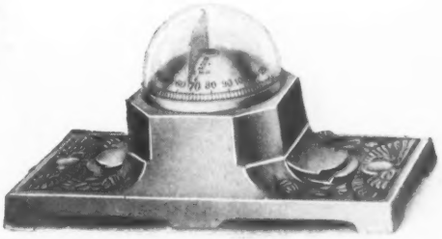
It consists of a sled frame on which is mounted a motor that drives a saw trailed along at the rear of the machine. Connected with the arms that support the saw is a lever operated by hand and adapted to raise and lower the saw to cutting position.

A gage arm, mounted on the frame of the machine, may be adjusted so the saw will travel in a path that will cut blocks of ice of any desired width.

Wireless Messages Recorded

OUR amateur wireless telegraphers may now record the messages they receive upon a tape, thanks to a new device developed by Mr. William G. Finch, of Buffalo, New York. Instead of the familiar buzz in the telephone receivers, the dots and dashes will be printed upon the tape, and even the messages sent by the fastest operators will be read at leisure. An ordinary printing telegraph machine is used to record the messages. This is actuated by an ultra-sensitive relay through which the radio currents pass.

This device may make the hobby of radio even more popular than it is now.



Reading the Temperature

WITHIN the crystal hemisphere shown above can be seen a scale of degrees ranging from the negative side of zero to 120 on the positive side. An indicator moves along this scale and accurately indicates the degree of temperature in the room.

Every house should be equipped with a means of finding the temperature. If the thermometer is attractive in appearance, so much the better.

This new thermometer is so sensitive that it will respond to a draft of the breath. The indicator is in the design of a small flag which moves to the correct degree of temperature.

Temperature is as impossible to estimate precisely, as it is impossible to estimate the degree of light in a room. One knows when a room is dark or light, hot or cold; but not how dark or cold. A thermometer enables one to keep the temperature constant.

Clean Your Shoes on a Skate

A DOORMAT will take the dust and light dirt off your shoes if you shuffle across it, but it will not remove cakes of mud. If you have an old double-runner skate around the house, fasten it upside down on the edge of one of the steps leading up to the door that is most used.

When you arrive home with mud on your shoes, you can remove it neatly and thoroughly by scraping your shoes against the sharp protruding edges of the skate. Of course a single-runner skate will do the job too, but you will have to balance your foot on it. And another disadvantage: one runner will do just half the work of two.

Mother will find this adaptation of the skate of wonderful value in helping her to keep the house free from mud.

Sculptures from Cheese

MUST cheese always be made in the conventional square and circular shapes? Not while the artistic Italian has time to mold it differently. Caciocavallo cheese is very plastic and lends itself to the making of weird figures like those shown above. After they have been molded, they are rubbed with olive oil and smoked for a few minutes over a wood fire. They come out a dingy brown.

Caciocavallo tastes much like Parmesan cheese, and is used chiefly for flavoring soup and spaghetti. The word Caciocavallo means "horse cheese," though the cheese itself is not made from mare's milk. It is supposed that the trademark used by the original makers was a horse's head.

It's a Hot-Water Bottle for Teeth

PREPARE yourself for future toothaches by getting a tiny hot-water bottle like this one. It is so small that it will fit snugly between your gum and your ailing tooth. It holds half an ounce of water, and will give out enough heat to relieve almost any toothache.

When you hold hot cloths to your cheek at toothache time, much of the heat is lost before it reaches the tooth. With a hot-water bottle directly against your gum, none of the heat is lost and you are relieved quickly.

We hasten to add that no amount of heat will keep off the dentist for an indefinite length of time. This tiny hot-water bag may be utilized for an ice-bag, should such a tiny one be needed, provided the ice is chopped small enough.

Stephenson's Engine Rebuilt

"STOP the train! There's a cow on the track!" At that the engineer shut off the power, jumped out, and chased the cow. This took place in the year 1829, and the engine in question was the "Rocket;" it was one of the first to be made in England by George Stephenson, the inventor of the first steam-locomotive.

Today there is a second "Rocket," made by a moving-picture company. It is an exact copy, even to the smallest detail, of the original one. It has the same huge driving-wheels in front, a blast-pipe, and tall chimney from which the steam escapes, two eight-inch cylinders, and an internal water-surrounded firebox.

The original "Rocket" entered into a race with two other engines and was the only one to finish.

How We Waste Timber

ONLY forty per cent of our timber is used. The other sixty per cent is in such shape after the boards have been cut that it represents nothing but waste. This is a startling fact, but nevertheless true. Some attention is being paid to the use of this waste in manufacturing from it such products as alcohol, tanning extracts, turpentine, pine oils, fiber for rugs, linoleums, and carpets. These are just a few of the products that may be obtained from sawmill waste that is now being thrown away.

A Ship Without Smokestacks

THE ship below is complete with everything but a funnel. It is propelled with Diesel engines and therefore it does not need a funnel like coal-burning ships. Diesel engines burn crude oil and the residue gases are exhausted through small pipes. On some German ships hollow masts serve as exhaust pipes. No draft is needed.

The great engines installed on this ship have a tremendous power—forty-five hundred straining horses would be needed to rival it.

Africa is the name of the new ship, and it has a length of four hundred and fifty-five feet. All the winches and steering-gears are driven by electric motors. It is the most modern ship afloat.

Popular Science Monthly

© Harris & Ewing

Save the Mail from Fire

SHOULD accident bring down a mail-carrying airplane in flames, the loss might be minimized by the use of sacks made of fireproof material.

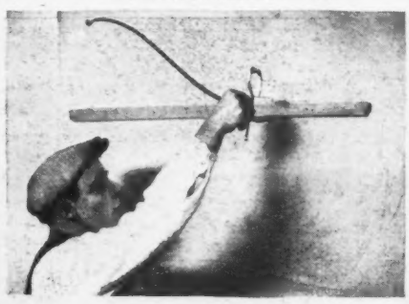
Of course, exposed to the full fury of exploding gasoline, there is nothing that would be an absolutely fireproof device. The heat generated would be so great that the paper enclosed in the asbestos covering would be "distilled" even if it did not actually burn. However, asbestos sacks would be a greater preventive of complete destruction. Though the material itself would become very hot, the letters would not suffer as much damage as from sacks of ordinary material.

A Daredevil Wooden Horse

"MY kingdom for a horse!" shouts Willie, aged five. But Willie's kingdom isn't very large, so his chances of getting a real horse are very small. However, if he shouts hard enough and long enough, his parents may buy him a wild wooden one like that shown below. The daredevil rider is also made of wood.

Both horse and rider are appropriately painted in gay colors, which increases their fierce look. They are mounted on a flexible brass rod, and sway gently back and forth at the slightest touch. And when Willie pulls them around they ride furiously.

Few people have given much thought to the psychology of toys, but is it not possible that Willie's love for the toy animals has influenced his love for the live ones?



This Hanger Clamps to the Molding

FOR hanging bird-cages, flower-baskets, and the like from a wall, Allen Burrows, of Los Angeles, California, has devised a hanger that clamps to the wall-molding.

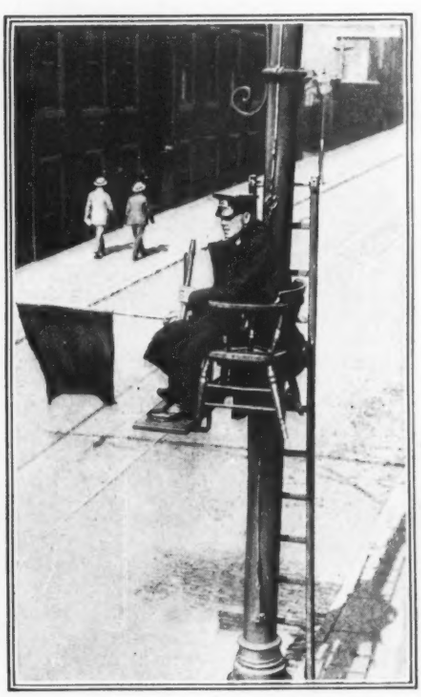
The hanger consists of a lower forked member that engages under the molding and a pivoted clamping member that engages over the top of the molding, to secure the device in place.

The long hook-arm on which the article to be hung is suspended is hinged to the clamp that engages the molding, so that the hanger may be swung readily to either the right or the left.

The Traffic Man's High Chair

DURING the repairing of a tramway route in Bradford, England, this observation post was installed for the traffic policeman, so that he could be seen from a distance. His personal comfort was considered as well as his efficiency, for which reason a chair was attached to one of the metal standards. By climbing a ladder a comfortable seat in the chair was afforded the signal officer. In the daytime he made use of a flag, and at night of a lantern.

The men who stand in the open to regulate the traffic of city streets are better able to do their duty if they are comfortable.



© Keystone View Company

Milk by Slot Machine

YOU put in a nickel and pull a lever; out comes a cup of coffee. That's the system in some of these wait-on-yourself restaurants. And now a London storekeeper has adopted the idea.

He sells large quantities of milk to the people in his neighborhood. Not wanting to spend too much time in the store, he had an automatic milk machine attached to the door.

A child comes along with her pitcher, holds it under a faucet in the door, puts her money into a slot, pulls a lever, and lo! a stream of milk pours forth. When the proper amount is reached the flow automatically stops.

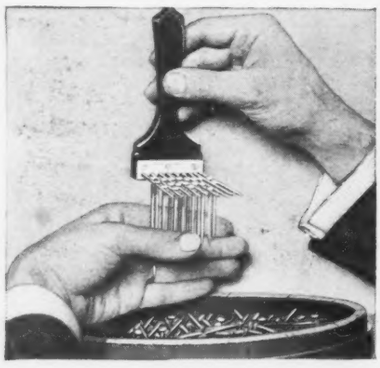
Comfort for a Traveling Dog

BUSTER MURPHY is a much traveled dog, and his master sees that he travels in comfort, housed in a portable conveyance. It is constructed from galvanized metal which is perforated at the top on both ends for circulation of air. A food and water receptacle is placed inside, with an extra supply of food in a drawer below.

The dog's name and his master's address are stamped on the ends of the kennel, while casters to roll it are placed beneath, and a hand hold is arranged for carrying it. It weighs little more than an ordinary suitcase—when Buster is on the outside.

Buster travels in more comfort than do a great number of humans. Surely there is nothing worse than a railway coach with its hot plush seats in summertime.

Clothing from Cows



Combing Out Nails from the Keg

BOX-MAKERS and others who use scores of nails usually have to dig with their hands into the keg to get the nails, afterward sorting and arranging them so all the heads are in the same position in order to pick them up rapidly and drive them into the box being made.

Mr. John Catinzearo, of Chicago, has invented a device to bring the nails from the keg ready for use.

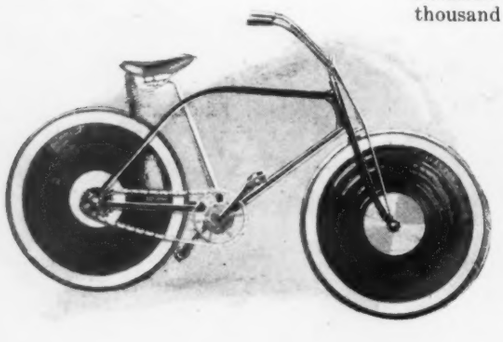
A simple wooden handle carries a head into which a number of metal pins, themselves nails, are driven. They are spaced just far enough apart to permit the nails in the keg to pass between them and to be held suspended by their heads. The workman drags the "comb" through the nails a few times, and dumps in his left hand those that have been caught in the teeth of the comb. The nails are thus already assorted, and the work is done in one tenth the time of the old method.

Solid Wheels instead of Spokes

SOLID wheels of wood have become so popular on automobiles that now they are being used on bicycles. Below you see a bicycle in which the usual wire spokes have been supplanted by wood. And, what is more, the tires on this bicycle are made of solid rubber; thus punctures become an impossibility and bicycle pumps as obsolete as the dodo.

Of course solid tires do not absorb shocks as well as do air-filled tires, but in these days of good roads there are not as many shocks to be absorbed as there were twenty years ago, thanks to the automobilist.

The elimination of spokes does away with the great danger to women riders of having their skirts catch.



A Bench Drilling-Stand that Is Adjustable

A MECHANICAL dwarf, less than a yard high and weighing only seventy pounds, yet having strength to hold a drill that bores into solid shafts of steel, is the way one might visualize the new bench drilling-stand equipped with an electric drill.

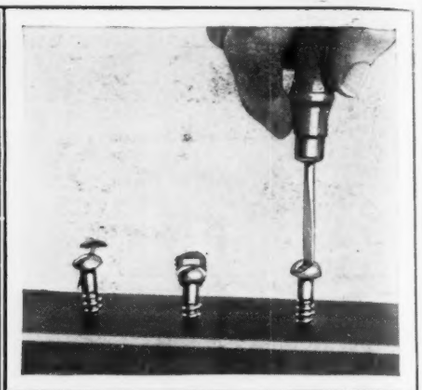
It would be impossible for a man to hold an electric drill by hand and accomplish the work done when the drill is held mechanically against the material into which it bores. This drilling-bench stand is so constructed that the drill may be swung clear of the base to operate on pieces of material that are too long to fit the bench. The bracket carrying the drill can be raised or lowered on the vertical column, and is secured firmly in any position.

Is It Good Flying Weather?

BEFORE you go up into the atmosphere with the airplane, call up the Weather Bureau and find out whether the wind is favorable or not.

Special reports are prepared daily from observation of captive test balloons. The direction of the air currents up to four thousand feet, their strength, indicated by the pull on the cable, and other information, are obtained from numerous weather stations. The balloons are sent up each morning.

Chiefly benefited by this information are the pilots of the aerial mail service. In making ong-distance flights they must know what weather is ahead of them.



Making the Screw Stay in Its Place

OFTEN it is desired by the workman that the screws he puts into the wood be permanently set. To prevent the removal of the screw with an ordinary screwdriver, the slot into which the screwdriver would fit is held in such a manner that the screw cannot be removed.

Three forms of slot-fillers have been invented by Fred Schumann, of New York city.

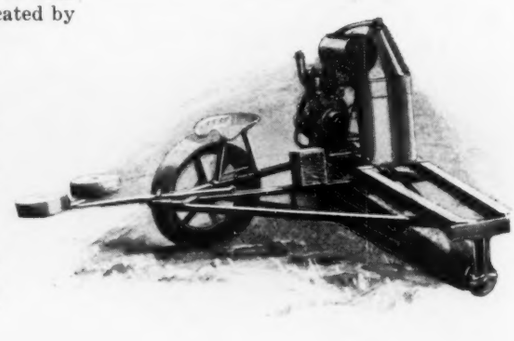
The first filler consists of a small segment conforming to the curvature of the screwhead, which is driven through a small hole drilled in the stem of the screw at a suitable angle. The second is a filler that is driven vertically down alongside the stem, completely closing the slot. The third is made by the simple expedient of merely tapering down the corners of an ordinary screw so the screwdriver will not engage the slot to permit the screw to be removed.

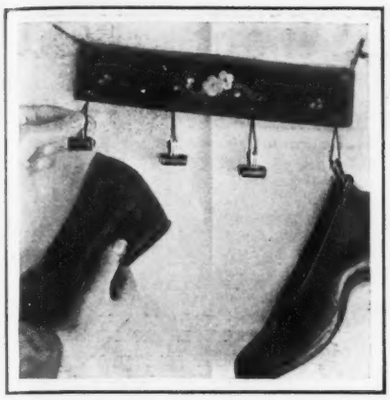
A Machine to Compress Silage

IN the wintertime cows usually live on silage; it is a fodder made up of cornstalks, sunflowers, and various grasses that are stored under pressure in a silo. The problem of compressing the silage to such a point that practically no air can get through led to the invention of the machine shown below.

The silo is filled with stalks and then the compressing machine is placed on top of them. A roller at the bottom of it moves in a circular path over the stalks, pressing them down. One man guides the machine and an engine gives it its power.

The engine weighs one hundred and ninety pounds and by its very weight helps compression. There is a small seat for the man who guides the machine.





A Place for Rubbers

WHAT do you do with your rubbers when you're not using them? Throw them in the corner of the closet, most likely, and leave them in a heap until you want them again. Why not make a rubber-holder like the one above and hang it up in some corner?

Line a strip of enameled cloth with oilcloth, and punch six holes in it, two in the upper corner to afford means for hanging up the holder. Metal clasps hang from the other four holes, which are along the bottom edge, and they grasp the rubbers in the back. Thus two pairs can be hung from one holder.

The clasps are of the kind used in schools and offices for holding together papers which must hang from the wall.

Testing Tiles on the Principle of the Nut-Cracker

IMAGINE a building-tile that represents a giant nut, and two strong steel girders representing the jaws of a nut-cracker, with a long steel beam as the lever-handle supporting an automobile at the far end as sliding weight.

If your imagination is at all good you will see at a glance how this giant "nut-cracker" works in testing the strength of the tile.

As the automobile is brought farther out upon the end of the lever, it increases the weight brought to bear upon the tile held between the heavy steel beams. A scale indicator is attached to show how many pounds the tile will stand before it bursts under the terrific strain. From this scale it was found that the pressure supported by the tile reached a point in excess of one hundred thousand pounds.

Clothing from Cows

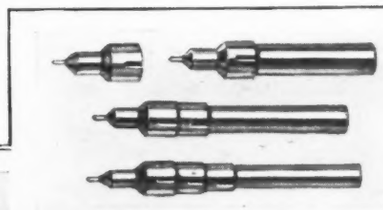
THERE is a certain breed of cattle, known as the Galloway, which is quite different from the usual breed. The animals have thick curly hair that can be used as wool.

The Galloways grew up in southwest Scotland, where a good overcoat is needed to keep the warmth in and the damp weather out. They have no horns, and it is thought that through the ages their original horns gradually disappeared, due to the fact that the country is too rugged for enemies to venture into.

Regulating the Phonograph Needle

A PHONOGRAPH needle has been invented that makes it possible to vary the tone to any desired degree of loudness or softness. It consists of a metal cap into which a needle of tungsten is fixed.

When this cap is placed on the shank, the loudest tone is produced, because the vibrating medium is shortest. But when a series of caps are interposed between that which contains the needle and the shank, a soft tone results.



The Handy Little Magnet

HAVE you a magnet for use in the house? When unruly phonograph needles fall upon the floor, as they have a bad habit of doing, a magnet with a long handle enables one to pick them up without sticking them into his fingers. It also collects the small steel balls that are used in the modern quill pen-holder.

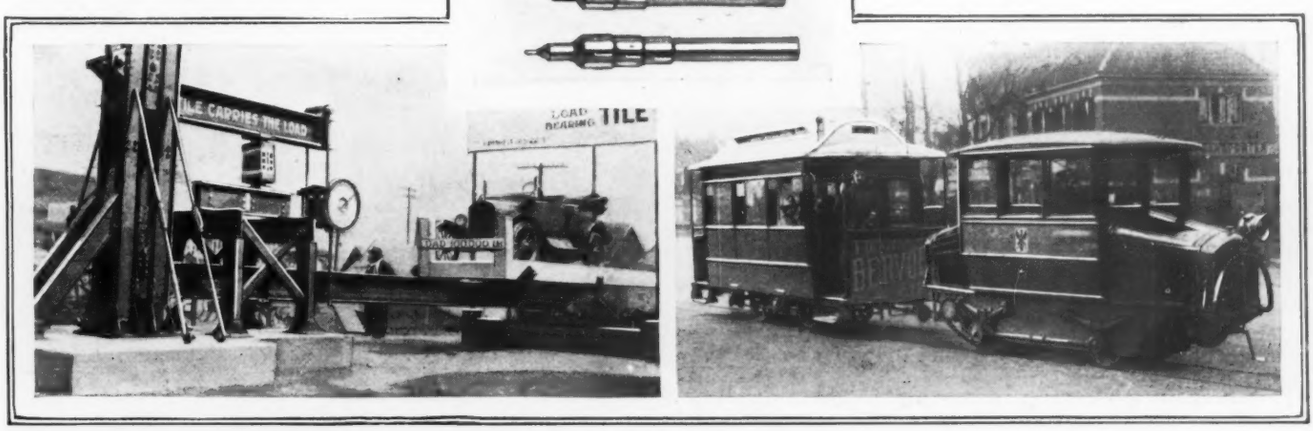
On a far greater scale, magnets are used to lift heavy iron weights in the steel-yards. They are also used to collect bits of iron filings and steel dust that collect in the vicinity of the mills. In the machine-shop they are indispensable. Steel splinters have also been drawn out of an eye by means of these metallic bars charged with one of nature's most mysterious forces.

A Tractor Helps Out in a Street-Car Strike

DURING a strike of power-house men in a large city in Holland, the automobile tractor here pictured was used to pull the street-cars along the tracks. It is about the size of a large limousine and is equipped with standard gage flanged wheels, and has a chain drive.

No doubt, in cases of emergency such as existed during the strike, the device would prove eminently satisfactory. Where people must travel a long distance to reach their place of business, they are not inclined to cavil at the mode of transportation used if the regular source is cut off.

However, it is to be hoped that no emergency arises which will necessitate the introduction of the idea to our busy American thoroughfares. But it beats walking!



January, 1921

If Jack Frost Could Be Put to Work

His great strength estimated in terms of horsepower

By Latimer J. Wilson

IN an area, as comparatively small as that included within the limits of New York city, Jack Frost makes use of more power than that which is used to run all of the industries in the whole civilized world.

When one steps outdoors in the morning and sees the ice on the pavement, he seldom thinks about any other work being done than that of his own task in removing the slippery sheets from in front of his premises. The trees in dazzling drapery of sun-glistening crystals, the soft fluffy blanket of snow, or the smooth hard covering of sleet may awaken esthetic ideas, but they do not turn one's attention toward the mechanical process of their creation. Yet Jack Frost has made them all in his gigantic ice-plant, and to appreciate his subtle work one must delve into concrete comparisons. As the manager of an ice factory, Jack Frost has his human competitors so far outdistanced that these comparisons become ridiculous. But they are extremely interesting.

The freezing waves create curious ice forms along the shore. Here is an ice-crater, hollowed out by the action of the water

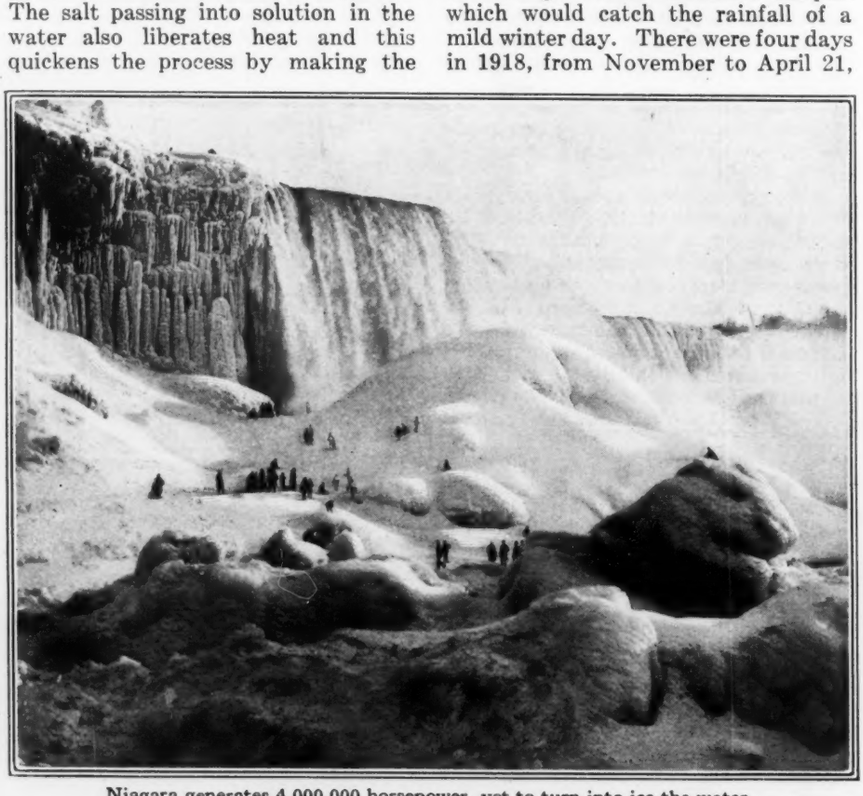
To move a one-pound weight 550 feet in one second, or to lift 550 pounds one foot in one second, constitutes what we call a "horsepower." The man in the street gages the strength of his automobile by its horsepower; it may be equipped with a ten, a thirty, or a sixty horsepower engine. To understand the enormous working ability of Jack Frost's industrial plant, we can best refer to its energy in the form of horsepower. If the man were to clear his pavement of snow and ice, he must apply his muscle to the job, unless he makes use of a horse and a snow-plow or a motor-driven snow remover. But, in any case, the amount of work applied to the task can be measured in terms of "horsepower."

Perhaps the sun comes out and warmly melts away the ice. In doing so it also exerts a form of energy that can be translated into the unit for measuring power. The amount of heat required to melt one pound of frozen water is conveniently expressed in units of heat, commonly called British thermal units. Just 144 of these units are required to melt that amount of frozen water, for water both freezes and melts at the same temperature. If we put 144 of these heat units into the one-pound cake of ice, we must take them from some source of heat.

In man's ice-plant at home, the ice-cream freezer, he cleverly arranges the apparatus so that the heat to melt the ice is extracted from the delicious mixture contained in the freezer. As the heat leaves the ingredients of the ice-cream, it freezes this material and passes into the mixture of salt and ice, helping to melt the ice. It is this process of melting the ice surrounding the container that freezes the cream. The salt passing into solution in the water also liberates heat and this quickens the process by making the ice melt more rapidly, thus more rapidly taking the heat from the container.

A refrigerating plant works upon the same principle. In one process the water to be frozen is surrounded by pipes in which salt-brine is circulated, the brine having been cooled by the evaporation of ammonia. Here the liquid takes heat from surrounding regions by the rapidity with which it turns from a liquid to a gaseous state. The evaporating ammonia extracts the heat from the brine, and that in circulation around the water-tanks reduces the water to a temperature slightly lower than the freezing-point. But for every pound of ice 144 British thermal units of heat had to be extracted from the water.

But how does Jack Frost run his ice-factory, making use of more horsepower than that required to run all of the industries in the world? The best picture one can make is that illustrated in an area the size of New York city, 17.5 miles square, 307.8 square miles, which might contain a shallow flat pan which would catch the rainfall of a mild winter day. There were four days in 1918, from November to April 21,



Niagara generates 4,000,000 horsepower, yet to turn into ice the water that goes over in one second would represent 18,000,000 horsepower

In blocks of ice often exceeding thirty feet in thickness the "jam" at the foot of the falls forms into a compact ice-bridge. To convert this ice back into the melted state takes from air and water and sunlight the necessary heat units

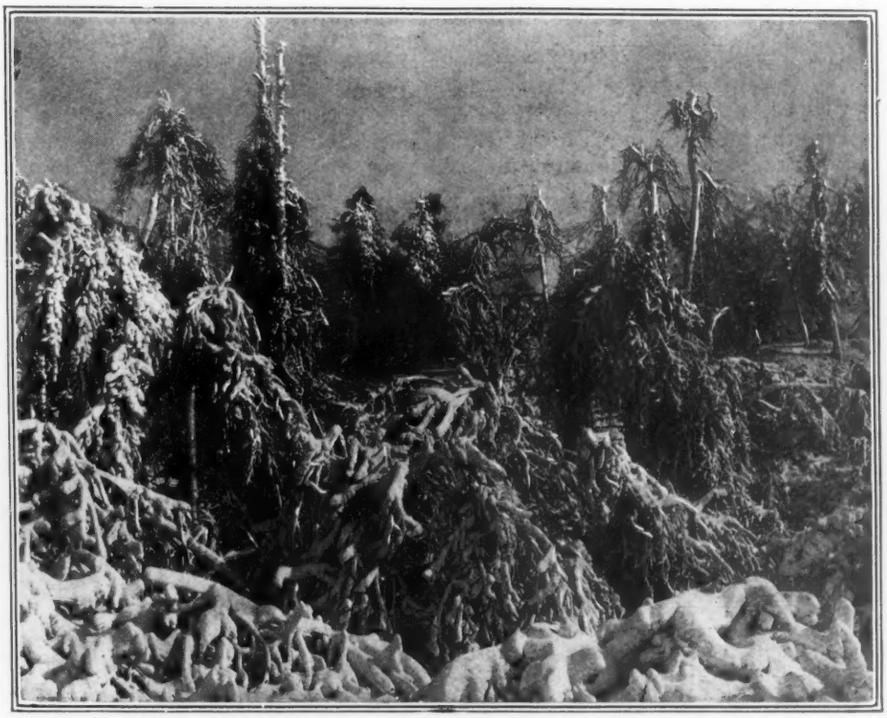
when one inch or more precipitation was recorded over the area of New York city. Now picture this huge pan of water being transformed overnight by the lowering temperature which Jack Frost carries at his disposal.

The units of heat required to freeze the water of even so small an area is too staggering to present a mental picture. No less than sixty-four odd trillion units of heat must be removed from the water before it is turned into ice!

What becomes of this liberated heat? It passes into the atmosphere, helping to temper it and partially taking away its keen edge of cold. When all outdoors is dripping with water that is turning into ice, the air is warmer than it is after the ice has formed, all else being equal. A strange anomaly it is that while the water is freezing the air is less cold. One may not often realize this condition because the moisture in the air produces a damp chill that is uncomfortable.

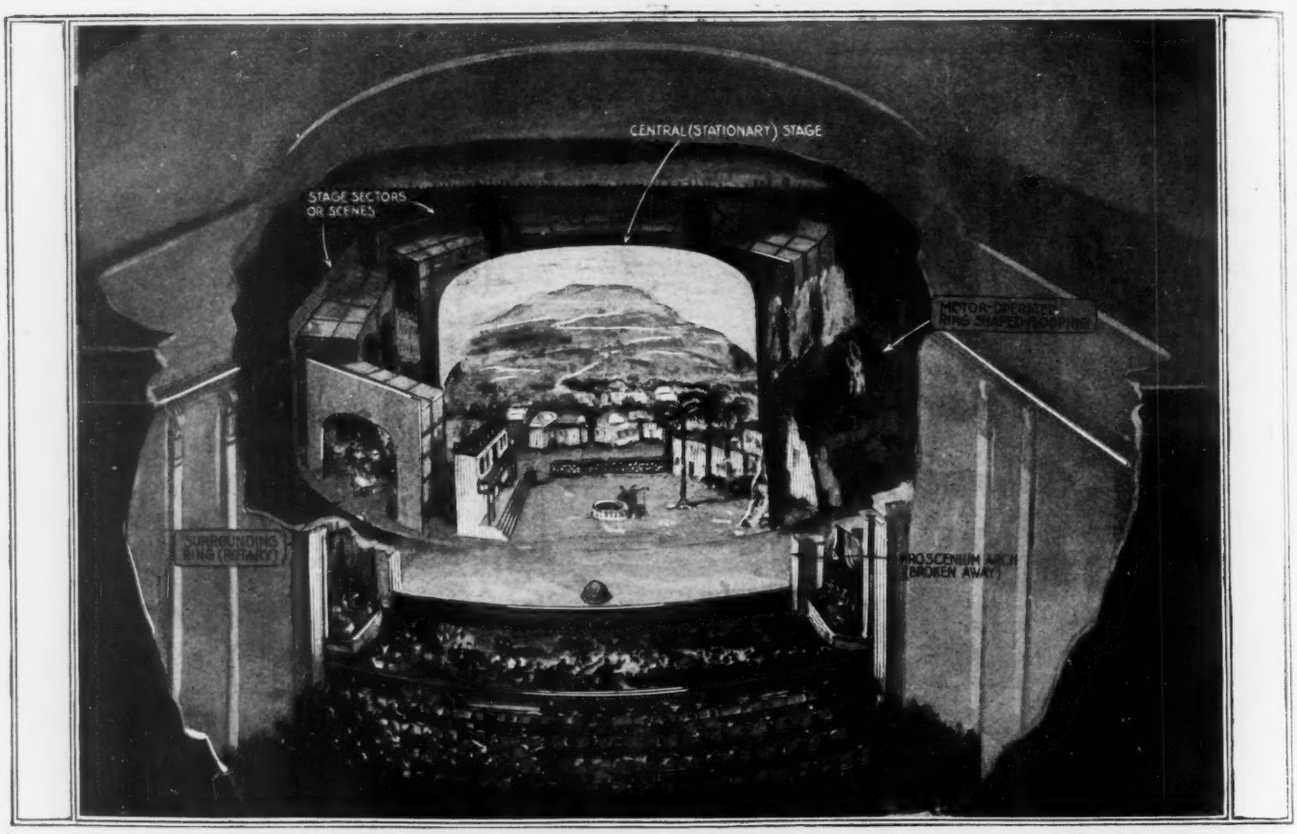
When the great pan of ice melts, the reverse conditions occur. The heat necessary to melt this expanse of ice must come from somewhere, and from the surrounding atmosphere it is mainly extracted, tending to lower the temperature of the air. But how about the horsepower? Actual calculations show that to melt such a cake of ice no less than sixty-four odd trillion units are involved, in other words, 916,403,891,235 horsepower!

It is thus seen that Jack Frost, in one of his overnight rush jobs, uses about 300,000 times more horsepower than that obtained from all our combined resources.



Jack Frost is a subtle sculptor when he coats the shrubs and trees with snow and ice. The spray of Niagara is here seen frozen on the trees

January, 1921



Seven Scenes on One Big Wheel

Now comes the stage on wheels. In fact, the stage is one big wheel with the scenes of the play arranged around its periphery. When an act is over, the wheel is turned and the next scene comes into place in a fraction of a minute.

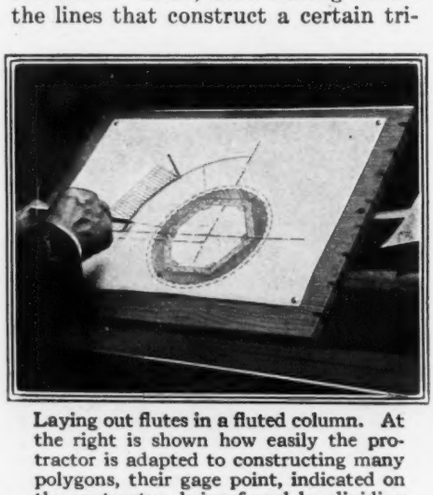
The rotary stage is the invention of Gustav Dumont, manager of the German Opera, Charlottenburg, near Berlin. The stage will accommodate seven scenes. It can be turned either by hand or by electric motors. Let us hope that the motors don't run wild some time. If the stage turned too fast, the scenery would certainly be precipitated on the audience

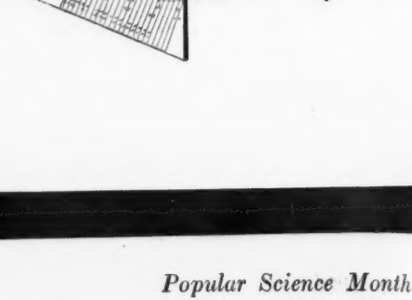
Speeding Up the Work of the Draftsman

WOULD you draw a polygon, or would you find the length of a line that equals the arc of a circle, or do you desire to draw quickly the flutes in a fluted column? If so, here is a new kind of protractor that will accomplish the work with speed and simplicity. It is as valuable to the draftsman and the carpenter as a counting-machine is to the man who must handle long columns of figures.

Measuring the angles of a circle, a draftsman depends for precision upon the aid furnished by a protractor. Geometry is a very ancient science, and the triangle, the square, and the protractor have their origin in the remote past of human history. But now a new kind of protractor has been invented by C. Schreiber, of San Francisco.

This protractor is so scaled that it may be used as having 360 degrees representing the divisions of a circle, but its numerals are so arranged that when it is convenient to divide a semicircle, divisions of 90 degrees are indicated, thus giving 180 degrees to the complete circle. Suppose one wishes to find the length of an arc of 60 degrees, the radius of the circle being known. With this radius a curve is drawn about one eighth part of a complete circle. The protractor is placed so that the measurement scale on the straight edge exactly touches the curvature of the circle. Then, after having drawn the lines that construct a certain triangle, a single change to a specified degree on the measurement scale of the protractor will enable another set of lines to be drawn which will produce the line that corresponds to a length of 60 degrees of the circle. Thus, with but two positions of the protractor, the work is accomplished. On the face of the curved edge of the protractor are indicated gage points from which polygons that are not in even degrees may be laid off. To construct the fluted columns of an architectural plan, after determining the number of convolutions desired in the column, the gage point is obtained by dividing 90 degrees by the number required in a semicircle.





Laying out flutes in a fluted column. At the right is shown how easily the protractor is adapted to constructing many polygons, their gage point, indicated on the protractor, being found by dividing 180 degrees by the number of sides of the polygon desired

Which Side of Your Face Is More Intelligent?

"GOD has given you one face," said *Hamlet*—but he did not mention the fact that the two halves of it are often startlingly different. Perhaps he, like most of us, did not know it. Yet photography has proved that one side of the face is usually more intelligent than the other.

Take, for example, the three photographs shown on this page. One represents a man's head as it actually appears. Another is made up of two left sides; this was done by printing the left half of the film on both its front and back sides. The third photograph represents two right sides. Yet see how different all three are!

The subject of this article as he actually looks. His face seems normal and symmetrical, yet the right and left sides are decidedly different

This photograph is made up of two left sides, printed next to each other. Notice the high brow, the well developed features, the intelligent expression

Two right sides of the man's face are represented in this photograph. The features are immature, the brow low, the expression uninteresting

Notice the high forehead, the intelligent expression and the well developed features in the photograph of the left side of his head; compare this with the uninteresting right side photograph. Yet when you look at the actual photograph of the man's head, you do not realize that there is so much difference between the sides.

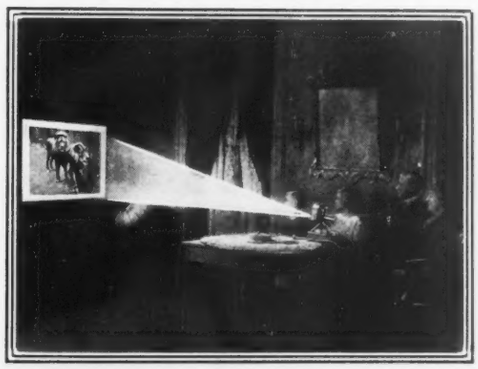
This man is right-handed, yet the left side of his face is more developed than the right side. This is due to the mutual crossing of the nerves that control the two halves of the body. The nerves controlling the right half of the body are centered in the left half of the brain. Our man uses his right hand more than his left hand and thus the left half of his brain receives more nervous impulses than the right; his face is similarly affected. Had our man been left-handed, the right side of his face would have shown greater development. Mrs. Alice Matzdorff, a Berlin photographer, made the photographs.

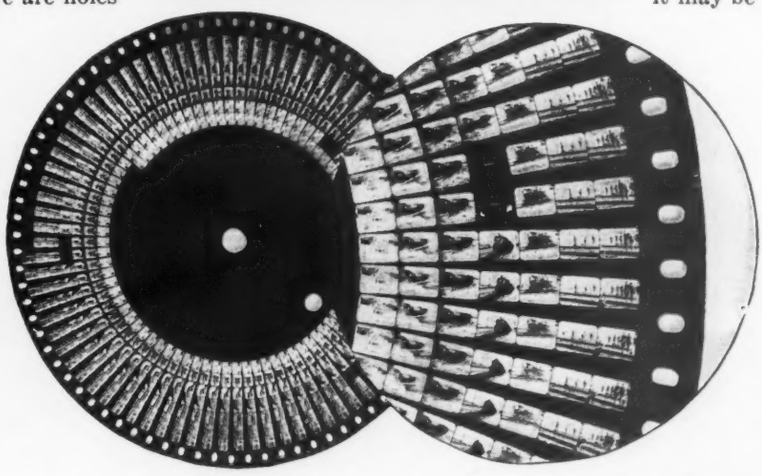
Moving-Pictures Made in Disk Form

MOVIES! That's what children cry for to-day. But you don't like to take your children to the movies unless you are sure that the pictures to be shown are fit for their young eyes.

Ah, but here is a picture machine for the home. It is cheap, easy to operate, and won't catch fire. The secret of its success lies in the shape of the non-inflammable film used. Instead of being in tape form, it is disk-shaped, and the successive pictures form a spiral on the disk. Near the edge of the disk there are holes for receiving gear teeth in the projection machine that make the disk rotate. This method of rotation reduces the wear and tear on both disk and machine that would occur if the disk were centrally rotated. The holes are slightly elongated to allow for any contraction or expansion that might occur.

When the handle of the projection machine is turned, the disk moves; and the pictures—starting at the outside end of the spiral—flash on the screen in rapid succession. However, the machine can be stopped instantaneously without blistering the film. Thus, when titles or captions are necessary, two spaces only are devoted to them. The operator simply stops the machine at the spot until he is sure that his audience has finished reading the words.





A disk-shaped film is used in this small moving-picture projector, and the successive pictures form a spiral on the film. The holes along the edge of it receive gear teeth that cause it to rotate when the handle is turned

A ten-and-a-half-inch disk contains twelve hundred pictures, and is equal to seventy-five feet of film. The projection machine is fundamentally the same as the usual moving-picture projector; however, it may be operated with a small dry battery when there is no electric wiring in the house.

The disk records can be made by the thousand at very little expense, and thus you are able to buy them at a small price.

This machine is useful because it is easy to carry.

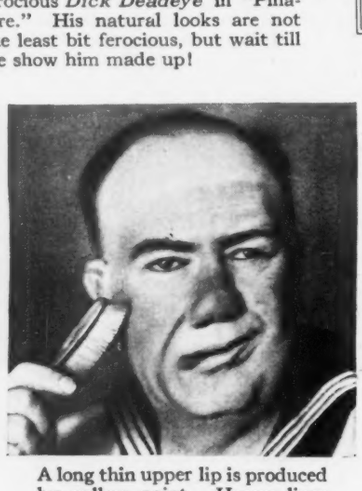
Making Up Dick Deadeye

What amateur actors can learn from Louis Cassavant

This is Louis Cassavant, well known for his excellent portrayal of the ferocious *Dick Deadeye* in "Pinafore." His natural looks are not the least bit ferocious, but wait till we show him made up!

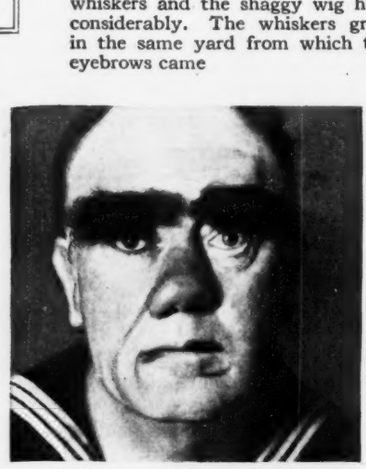
His first move is to erect on his natural nose a thick ugly putty one. He warms the putty, wets his nose to keep the putty from sticking, and then molds it on. Next he applies a grease-paint sunburn

Here he is! Not a bad villain, do you think? Of course the fuzzy whiskers and the shaggy wig help considerably. The whiskers grew in the same yard from which the eyebrows came



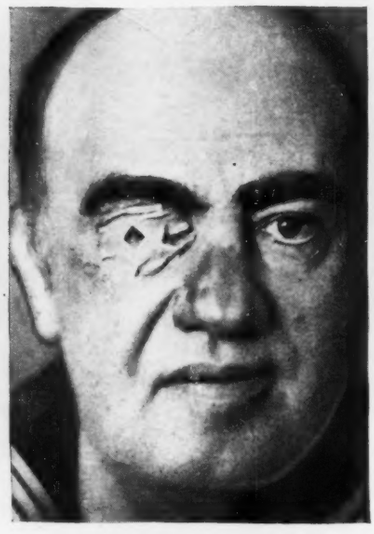
A long thin upper lip is produced by yellow paint. Heavy lines in the face are done in reddish brown. If Mr. Cassavant thinks his coloring is too heavy, he rubs some light powder on a brush gently across his face

Dick Deadeye has to blot out one eye in order to live up to his name. He does this with court-plaster, but leaves a small hole in the center to help him see. The audience, however, does not know this



The bushy eyebrows are acquired in the following way: Buy a yard of crape hair and pull out as much as you need. Smear some spirit gum on each real eyebrow, and then stick on the false ones

Be sure that the crape is on tight before you trim it. You can buy ready-made eyebrows that are easier to adjust, but you are never sure that they won't fall off at the most critical moment of the play

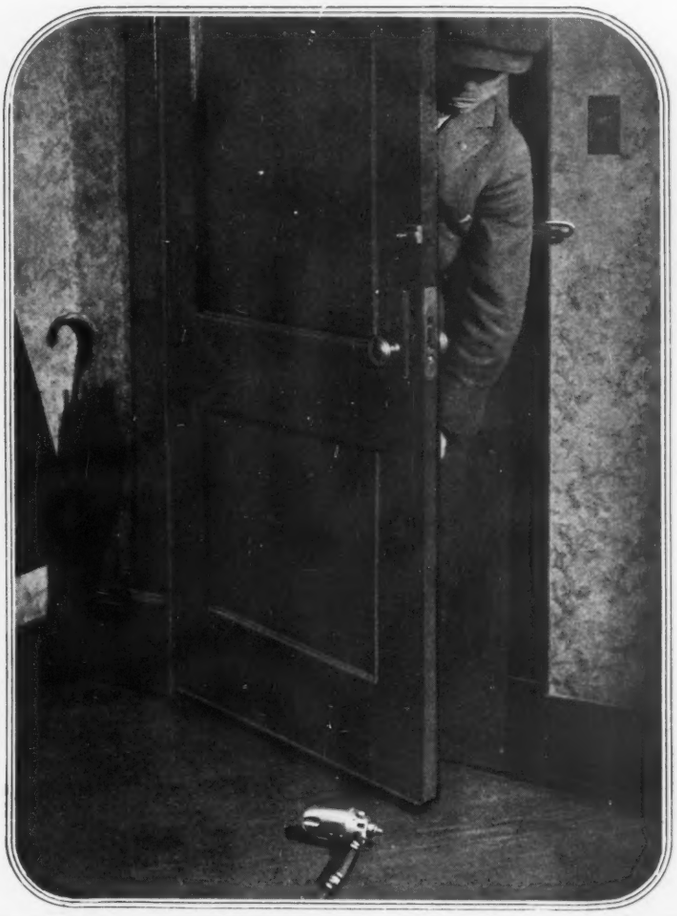


In a few hours all this work is undone. The putty nose is removed by string placed across the bridge, brought down the sides, and tied underneath. By pulling the string the putty nose is forced off

Scaring Off a Burglar

Strong nerves now needed for his profession

With such innocent-looking implements as those shown here concealed about his person, a burglar cautiously enters a silent house. Perhaps he is planning how he will spend his ill-gotten gains, when suddenly he sees—the woman below!



Silently he turns the knob of the door leading into the room where the silver is kept. But as he opens the door, there is a terrific pounding. Are the police breaking their way through to get him? He's off! The noise was made by an electric vibrator on the floor

A flash of light in the dark will scare the toughest burglar. Attach an "ozone generator" to the door, and it will shoot sparks when the door is opened. This device purifies the air and is popular in zoos

Here's a close-up of the mysterious woman who scared off the burglar mentioned above. As a matter of fact, she is not a woman at all! Just a dress form, placed in the doorway on purpose. The burglar sees the vague form, thinks it's a woman, and makes a speedy exit

Another door-knob trick. The knob is connected with an electric circuit and gives the burglar quite a shock when he turns the key. He suspects a trap and goes no farther

Toot! Less than a foot away, an automobile horn blares forth as the burglar opens the door. He is torn between fear and wonder, and decides to take no chances. As a matter of fact, the opening of the door closed a circuit, which caused the horn to toot; no one was in the room

Rescuing the Oyster Industry

William Firth Wells brings the cream separator to the aid of the embryo oyster

By Raymonde G. Doyle

A FEW weeks ago a telephone message was sent to the New York State Conservation Commission at Albany from a little town down Long Island way—West Sayville, home of the oyster industry on that part of the Atlantic coast. William Firth Wells, biologist and sanitarian for the Commission, was making a brief report on an important experiment. He was greatly excited.

"Sure," he said in effect. "No question about it. We've solved the problem of growing oysters artificially."

And then Mr. Wells went back to the little makeshift hatchery set up in the plant of one of the big oyster companies, and slapped his assistant on the back, and otherwise conducted himself like a pleased youngster.

As far back as 1879, a scientist from the staff of the Johns Hopkins University had attempted what the New York State biologist has succeeded in accomplishing. His experiments stopped just short of success.

In a laboratory in the town of Crisfield, Maryland, the Johns Hopkins man discovered that spawn could be taken from the female oyster and fertilized and that the eggs, in masses of 100,000,000 or so, could be kept alive in great jars of seawater provided the temperature were maintained at that of the ocean.

But at the end of six days, the period required for the oyster egg to hatch, the pioneer experimenter discovered that a tragedy was happening in his hatching-jars. The minute oysters were dying of starvation.

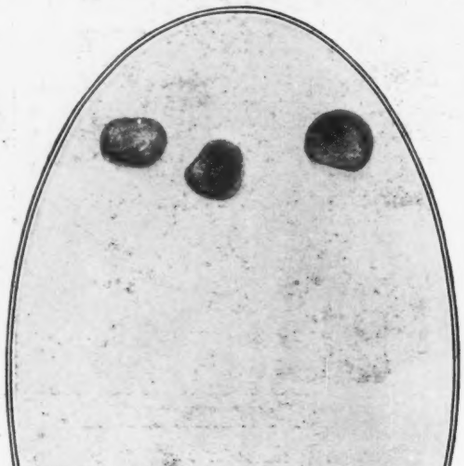
Changing the Water a Difficulty

The Johns Hopkins man immediately undertook to simulate free-water conditions in the jars. He tried to change the water on the theory that he would thus replenish the food supply and the oxygen.

Here he encountered dismal failure. There was no way of straining off the old water. The finest mesh screen was amply large enough to permit his young oysters to pass down a drain into Chesapeake Bay.

"What of it?" most persons would ask. "Didn't the young oysters fall into a natural home? Why bother further?"

There was the crux of the whole experiment. For years the oystermen had known that oyster eggs were hatching in their natural environment. The difficulty was that before the oysters arrived at the stage when they were ready to attach themselves to stationary objects on the ocean floor—"set" is the word used in the industry—tides and eddies swept them out of the sheltered bays and the oyster-beds, swept them into deep water, where temperature and other adverse conditions stunted growth or left them for the bigger creatures of the deep to eat. It was thus becoming more impossible every day to insure the future production of the oyster-beds.



Here are some newly hatched oysters as they appear under the microscope magnified to one hundred times their natural size. Their elusiveness during the process of straining can be readily imagined

No matter how much care was taken in placing fertilized eggs, or even young oysters, in the beds, the motion of the water was dragging them away.

Young Oysters Need Care

The problem, then, was to hold the tiny oysters in captivity, so to speak, and to keep them healthy through the hatching and early feeding stages and on up to the moment when they were ready to "set."

William Firth Wells has done this for the oyster industry.

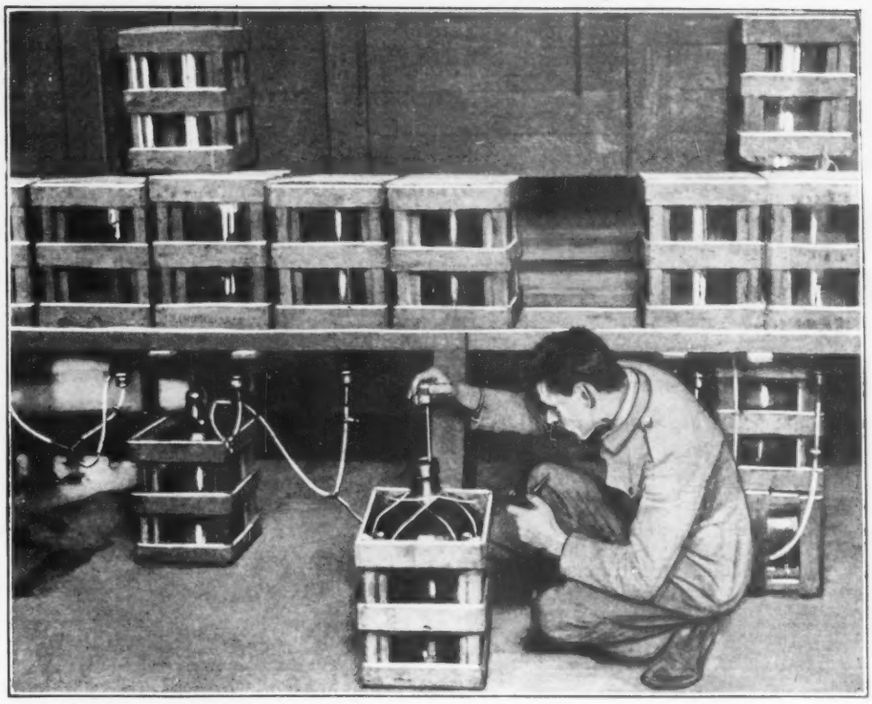
Less than a year ago, responding to the complaints of the oystermen

Mr. Wells wondered if the cream separator would kill the oysters. He is shown at the left studying them after their unique journey. He found that they thrived under the experience

along the New York coast, the Conservation Commission called Mr. Wells to Albany and laid the situation before him.

"Go down to Long Island and help these people," they told him. "The oyster industry has been slipping back gradually and you've got to save it."

So Mr. Wells took one of his assistants down to West Sayville and called on an oyster company to provide a small shed for a laboratory. Next he collected a lot of big spring-water bottles, some preserve jars, a microscope, thermometers, glass and rubber tubing, and other odds and ends of apparatus such as never before had been grouped together. The oyster company provided the eggs, and the biologist and his assistant set to work.



After emerging safely from the centrifuge, the oysters were transferred into fresh water through which was forced a circulation of oxygen by tubes that required very delicate adjustment

Ingenuity Wins the Day

They verified the causes of the failure of experiments performed in the past and then undertook to aerate the water in the bottles in which the eggs were being kept alive. They found that as the eggs hatched and became free swimming oysters, microscopic in size, they greedily ate up every bit of food in the water and then began to starve. When an attempt was made to change the water, most of the little oysters were lost. Aeration alone would not save them.

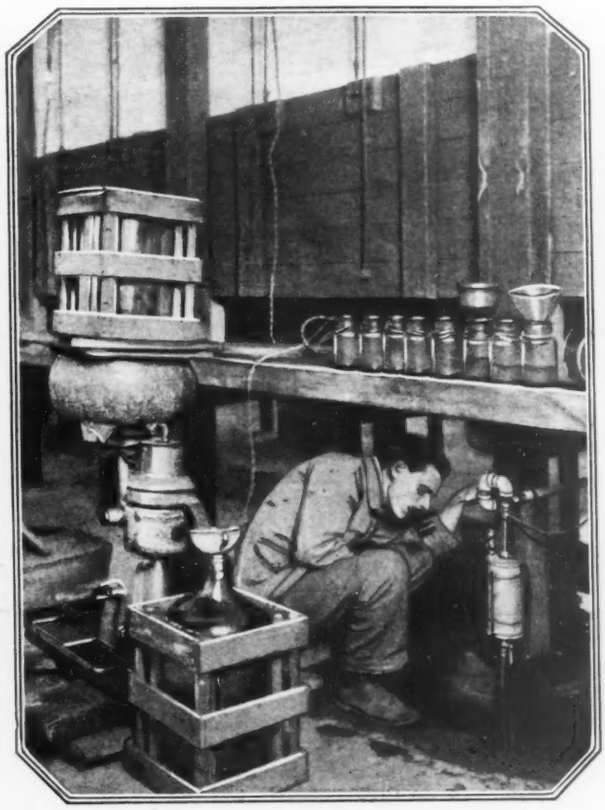
Right there the ingenuity of a Yankee came into play. Scientists will be startled at what Mr. Wells decided to do.

He telegraphed to a manufacturer of cream separators to send the best on the market to West Sayville. He argued this way: If a cream separator operating on the principle of a centrifugal machine separates cream from milk and lets it drain off as cream, why won't it separate the masses of tiny oysters from the water they live in, and let them drain off into fresh supplies of water?

The cream separator, or "centrifuge," as Mr. Wells prefers to call it, was set up in the laboratory. A batch of some hundreds of thousands of artificially spawned and fertilized eggs was watched closely until the hatching stage had been reached and completed. At the point where the microscope revealed the little oysters to be assimilating food, preparations for changing the water were made.

Sufficient time was allowed for the consumption of the food particles with which the original water was filled, and then, one by one, the big bottles containing the tiny oysters and the water from which they had extracted all the food were emptied into the centrifuge container.

The first experiment of its kind in history was on Mr. Wells turned on the current. The machine began to operate, and the water with its thousands of little oysters began to whirl. Faster moved the mass and presently centrifugal force compelled a concentration of the tiny oysters precisely in the same manner that cream is concentrated from milk. Finally, when the concentration was perfect, the valve at the side of the machine was opened and the oysters, pushed out by centrifugal force, fell into small bowls from which they were transferred to new supplies of water. Then a suction aeration system forced oxygen through the water.



At the left is shown the cream separator, or centrifuge, untended for the moment, while Mr. Wells inspects the air-pump that regulates the aeration process

Examinations under the microscope were resorted to again to determine if the trip through the machine had injured the oysters. No damage was discernible. The few days in which they had been free swimmers were sufficient for the formation of the first layer of shell, and, delicate though it was, it had protected the animal life.

Throughout the developing stage, Mr. Wells and his assistant maintained constant vigilance, waiting for the oysters to sink to the bottom and exhibit a tendency to "set." At the first sign of such tendency the oysters were taken to the "beds" and dumped.

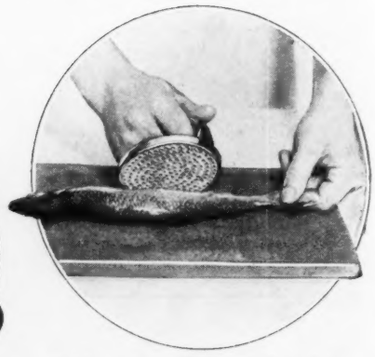
They sank to the bottom and fastened themselves to rock and shell formations, there to remain until big enough for the market.

January, 1921

Things that Every Housekeeper Should Have

Few butchers trim meat before they weigh it. You can do the job well yourself if you use this combined skinner-slicer-trimmer with its sharp curved edges

One tainted apple in a bowl with good ones will soon rot the good ones. That's the chief reason why the nickel-plated fruit-rack above was invented

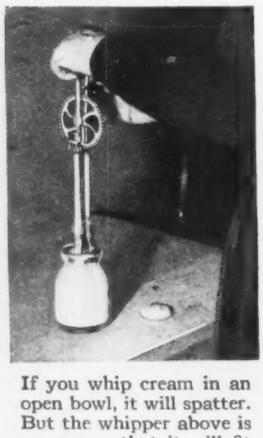


Scales are useful to a live fish, but when preparing it for eating, they become a nuisance. A grater with a bath-brush back will remove these scales rapidly

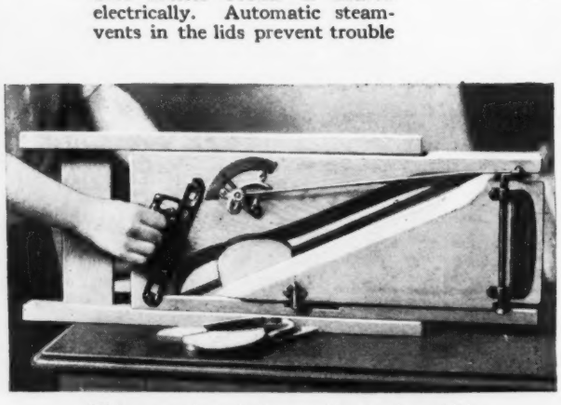
Here's a homemade scale. Fill a jam-jar partly with water. In it place a test-tube containing pieces of metal to keep it upright. Fit a cork in the tube and attach a strip of cardboard to it. By placing various weights on the cork you will be able to mark a scale on the cardboard

This fireless cooker is heated electrically. Automatic steam-vents in the lids prevent trouble

When milk comes to a boil it spreads itself all over the stove. The device shown above prevents this. The milk is heated in a pot that has a spout. When the milk boils and rises, it gushes out of the spout into another pot, which causes a lever to lift the original pot from the flame



If you whip cream in an open bowl, it will spatter. But the whipper above is so narrow that it will fit inside the cream bottle and eliminate waste and trouble



This new bread-slicer adjusts the width of a slice by means of a pointer and then you pull the slicer backward and forward

Here is a pull-chain device that fits over an ordinary electric switch and enables persons of average height to adjust with ease lights that are too high to be reached otherwise

Keeping Up with the March of Science

Facts for the man who wants to know

The Chemical Effect of Light

ENGLAND'S greatest authority on the physics of low temperatures, Sir James Dewar, has shown that some phosphorescent bacteria, obtained from sea water, will resist the temperature of liquid hydrogen 252 degrees below zero (Centigrade). The bacteria do not give off light when they are killed. Frozen in liquid hydrogen, they cease to be luminous, to be sure; but when the temperature is raised they shine again and prove that they were not killed.

Dewar kept the bacteria in the liquid hydrogen six months before thawing them out. In the frozen state they resisted all attempts to destroy them. Corrosive chemicals, biting acids, caustic alkalis—all had no effect.

It occurred to Dewar that they might not come to life again after having been exposed to ultra-violet light. He found, in fact, that they could not be revived, which proved that light does produce a more profound chemical effect than any chemical.

Germs that Feed on Sugar

ABOUT one per cent of the Cuban sugar crop, valued at $1,500,000, is each year destroyed by greedy microorganisms too small to be seen except when congregated in crowds of millions. Molds and bacteria are the culprits. It is estimated that each person in the United States consumes 81.84 pounds of sugar each year. At this rate, 873,000 persons could be supplied with the sugar destroyed by germs.

The sugar loses its sweetness when the molds consume the sucrose, its "sweetening" principle.

Why Is the Sky Blue?

NOT one in a hundred persons can tell why the sky is blue, or why the sunrise and sunset are red. But any one can easily demonstrate the working of the "blue sky" law of nature.

Blow a film of smoke into a darkened room, and admit the light from one window only. Look at the smoke against the dark background of the room and its color is bluish, but look through it at the light and it appears reddish. The interception of the blue rays by small particles in the atmosphere produces the blue color. The red rays carried in white light jump the gaps between these particles.

A Chinese Monopoly

EVEN the dye on a firecracker is controlled by a trust—this time Chinese.

How the dye is produced from a Philippine wood is told by Luis J. Reyes, a Filipino student at the New York State College of Forestry at Syracuse, who came here to complete his education, after graduating from the forest school of the Philippines. Mr. Reyes brought with him one hundred and fifty identified species of woods from the Philippines, and among them is the so-called "sapan," known by the Chinese as *soo mook*, but scientifically known as *Caesalpinia sapan*. In the Philippines it is known also as *sibukau* or *cibucao*, and it is one of the best known of the Oriental dye-stuffs.

A strong combine of Chinese firms in Hong-Kong is said to control the importation of this wood from the Philippines. It makes the red ink or paste used not only by the Chinese for firecrackers, but also to ink the seals that the Chinese use in certifying official documents.

According to Mr. Reyes, the wood originally produces a color resembling the yellow of American logwood; but this is treated until it becomes a red of the familiar firecracker shade.

Clay Phonograph Needles

LIKE Adam, the latest talking-machine needles are shaped from clay. It has been found that clay of a certain kind, when cut from the shale-banks and properly dried, can be made into perfect needles capable of producing marvelously clear tones from phonograph records. Without grain or grit these needles, after being fired at a temperature of 2000° F., become sufficiently hard to play a record two hundred times.

The shale is first cut in sections about six inches square, and is stored in paraffin-coated sacks to prevent too rapid drying by exposure to the air in their moist condition. Then the sections are placed in a drying compartment where they are slowly dried. A saw afterward cuts them into strips three quarters of an inch long and one eighth of an inch square, after which they are ground to the perfect form of the ordinary steel needle. These are put into an electric kiln and heated to the intense degree necessary to harden them.

Automobile Gases that Kill

WHEN an automobile engine runs in a closed garage, which is apt to happen in winter, poisonous carbon-monoxide gas is given off that may kill.

G. A. Burrell and A. W. Gauger, of the Bureau of Mines, have made an intensive study of the subject, and their conclusions ought to be driven home to every automobile-user. Exposure to an atmosphere containing only 0.20 per cent of carbon-monoxide will cause a man to collapse in an hour; exposure to as little as 0.05 per cent will cause headache after a few hours.

No two men are affected in the same manner. Curiously enough, a man at work is overcome more quickly than a man at rest. One of the investigators was extremely ill for eight hours after exposure for twenty minutes to air containing 0.25 per cent of carbon-monoxide.

Last of Lebanon's Cedars

DURING the war the hand of destruction fell heavily upon the age-old cedars of Lebanon. These trees, which date back to ancient history, were famous during the wars of Sennacherib, 608 B. C. The Roman historian, Pliny, claimed their wood to be eternally durable, and the Arabs are said to have believed the trees had existed for all time.

After two thousand years the timbers in the ruins of ancient Assyria were found unchanged. In remote times the oil from the cedars was used as a cure for leprosy. It was also used by the Romans for preservative purposes. The huge cedars are often ninety feet in height and forty-two feet in circumference.

During the world war the Turks cut down many of them to obtain fuel for locomotives, and the opposing forces continued the work of destruction for military purposes.

Rust-Proof Steel

THE Bureau of Standards has made a study of rust-proofing methods, and has published the results in a paper that ought to be read by every metal manufacturer. Coatings, paints, lacquers, varnishes, and enamels of all types are considered.

It is shown that zinc is the best protective against corrosion. Zinc coatings were tested by the "salt spray" method. The article to be tested was exposed to a fine mist of saturated salt solution. By measuring the time that corrosion was resisted it was possible to determine the service life of the protective coating.

The Big Family of Sugars

SUGAR obtained from sawdust is not the usual table sugar, according to the chemists of the New York State College of Forestry at Syracuse, but an entirely different substance, one of the many so-called "sugars" derived from different sources, and entirely different in chemical form. The public hope, therefore, that sawdust may be used to relieve the present famine in cane sugar is not likely to be realized for a long time to come, if ever.

"An important sugar can be prepared from sawdust by hydrolysis with acid," says Dr. L. E. Wise, professor of forest chemistry at the New York State College of Forestry; "but it must not be confused with the sugar of the breakfast-table. This sugar, prepared from wood, is dextrose or glucose, and is identical with the sugar obtained by acid treatment of starch. The sugar is not identical, however, with sucrose, commonly termed 'cane sugar' or 'beet sugar.' Glucose is, however, widely used commercially, and is an important food-stuff. It is the principal component of corn syrups and the like, and has distinct nutritive value. As sucrose

January, 1921

can not be prepared from glucose, either commercially or in the laboratory, there is little prospect that such a synthesis will be an accomplished fact in the near future.

"The commercial production of glucose from sawdust or other sources probably merits thorough investigation. On the other hand, it should be clearly understood that glucose is not cane sugar, and that the term 'sugar,' as commonly used by the layman, refers to sucrose or cane sugar. There are many sugars; in fact, they comprise a most important group of organic compounds, and different species of trees have produced different sugars."

Bricks from Furnace Slag

THE slag from blast-furnaces has until recently been an all but worthless by-product, except for its use in making cement. If a process perfected in Germany comes into general use, slag will become a useful substance.

The slag is dropped into water, and the steam generated blows out the heavier substances, producing a material that resembles pumice-stone. This is crushed and mixed with a special bond and pressed into bricks. These bricks are rapidly coming into use in Germany for housebuilding purposes.

Goat-Skins for Gloves

KID gloves are made of goat-skins imported from India. When they reach the United States they are tanned by the chrome process for the production of glacé kid.

India is one of the principal producers of these skins, and before the war skins were tanned there and shipped to London for disposal. India has recently imposed a preferential duty on the export of goat-skins, and this will eventually affect the price of kid gloves in this country.

Balloons Find Air Currents

AIR currents high above the surface of the earth often reach a speed of one hundred and forty miles an hour, as has been shown by experiments conducted by the Weather Bureau at the University of Wisconsin.

One of the balloons used reached a height of twelve miles. Besides showing the direction and speed of the air currents, the balloons also show the height of the clouds and the clarity of the air.

Luncheon in Formosa

HUMAN beings have been known to eat white ants, June bugs, frog pancakes, white mice dipped in honey, locusts, mole soup, birds' nests, and cooked chrysanthemums—why not dogs' feet?

In the island of Formosa dogs' feet are a great delicacy. Many people who read this will throw their hands up in horror, forgetting for the moment that they like pigs' feet themselves, to say nothing of ox-tail soup and calves' brains.

Killing Rats with Poison Gas

THE Chemical Warfare Service has recently demonstrated that rats can be killed with poison gas.

A mixture containing thirty per cent of phosgene and seventy of chlorine was used. This was allowed to escape over an area of nine hundred square feet. Fifteen rats were on the area, and they all died from the effect of the deadly poisonous gases.

They were killed at a cost of forty cents. Within fifteen minutes the phosgene had dissipated, while the chlorine gas required thirty minutes to diffuse beyond the danger point.

In view of the millions of dollars' loss caused yearly by these pests, any means of destroying them is welcome.

Be Careful of Canned Foods

CANNED foods are perfectly safe to eat, provided the proper precautions are taken before the food is used. If the can is swollen in the least, gas has been generated, and this is always an indication that some chemical reaction has taken place. The food in cans found in this condition should never be eaten.

When the can is first punctured, the sound of escaping gas should be a warning not to partake of the contents. Food with an unnatural odor should be regarded with suspicion.

Calcimine a Fire Resistant

ORDINARY calcimine or whitewash can be used to make wood fire resistant. Experiments along this line have been conducted by the Forest Products Laboratory at Madison, Wisconsin. Wood covered with this preparation has been found to be more resistant to fire than many other more costly substances.

Calcimine will not protect wood at the higher temperatures, but it will decrease the danger of fire spreading from lighted cigarettes, sparks, and matches.

Radium and the Heart

A HOLLANDER, Dr. Zwaardemaker, caused a frog's heart to stop beating and brought it back into action by the use of solutions containing radioactive elements. Various injections of non-radioactive elements failed to produce any noticeable effect. Doctors are recommending diets containing vitamines. Will they change to a mesotherium cure for all ailments? About the only common thing that contains a radioactive element is the gas mantle. A diet of gas-mantles would undoubtedly prove to be very indigestible.

Asbestos Threads

ASBESTOS has been spun into threads so fine that they run as high as thirty-two thousand feet to the pound. The thread is woven into heat-insulating fabrics and incombustible yarn and rope. Only the better grades are used for this purpose. This is a recent development, and the Geological Survey of the United States Department of the Interior believes it to be of great importance.

Armor of the Ancients

METALLURGISTS have recently completed an analysis of several samples of steel taken from ancient armor. They found that it was made from very pure wrought iron converted into steel by the old cementation process. The microstructure of the sample showed that the process used in its production was very similar to the process in use at the present time for the manufacture of wrought iron.

The metal was hammered into sheets of the proper thickness, and these were then welded into larger sheets, which were again hammered into shape and given a final heating and quenching.

Prize for a Testing Machine

A PRIZE of $1000 by Sir Robert A. Hadfield has been offered for a metal hardness-testing machine. By this is meant a simple and accurate machine for testing the hardness of steel and other hard alloys.

The fund has been placed in the care of the Institution of Mechanical Engineers, 11 Great George Street, Westminster, London, S.W., England. Here is an opportunity for readers of Popular Science Monthly to prove their mechanical skill.

India's Wild Beasts

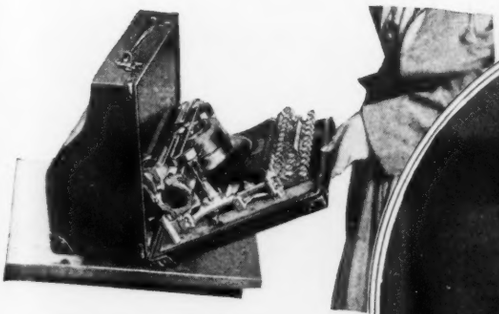
INDIA has a population about three times that of the United States in about one third the area; yet in that crowded country the struggle against snakes and wild beasts claims astonishing tolls. The latest report indicates that last year 55 persons were killed by elephants, 5 by hyenas, 109 by bears, 350 by leopards, 309 by wolves, 853 by tigers, and 688 by boars and other animals. Poisonous snakes claimed no fewer than 22,478 persons.

More than 19,000 wild beasts of various kinds were killed and 91,104 snakes were exterminated in the struggle. Recently high floods killed many of the small animals that are ordinarily the prey of wild beasts, and this probably accounts for the attention that tigers and other large animals have given to their human neighbors.

Clouds Formed by Airplanes

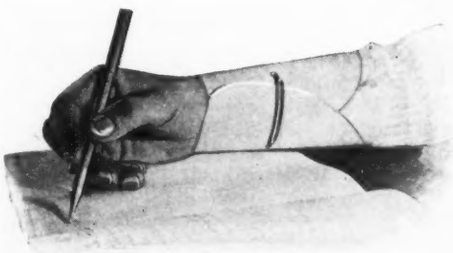
METEOROLOGISTS are beginning to believe that, under favorable conditions, the passage of an airplane through the atmosphere can result in the formation of a temporary cloud more or less surrounding the machine. Given the right degree of moisture in the air, there is every reason to conclude that the atmospheric water vapor will be condensed by the local changes of pressure produced. In the high-speed tunnel at Dayton the phenomenon has been noticed on a small scale.

A Few Suggestions for Higher Office Efficiency



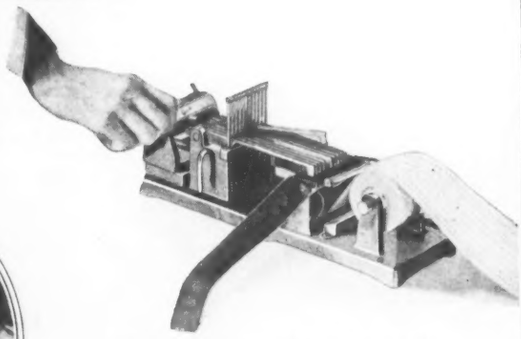
Here's the typewriter to take with you when you go off on a trip. It is made of aluminum and consequently is very light. The typewriter and case together weigh eleven pounds; a handle makes transportation easy

When will Mr. Smith return? A bulletin-board like the one above will enable you to see at a glance whether Mr. Smith is out, and if so when he is expected to return



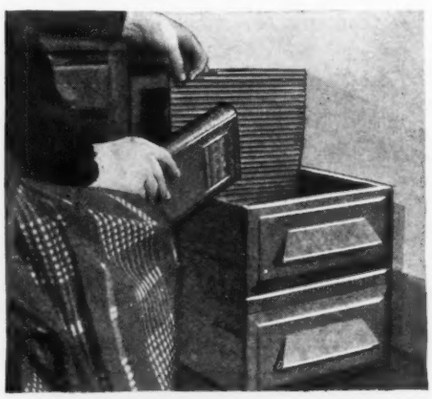
Office cuffs made of cloth are not so sanitary as the celluloid cuff shown above. It snaps around the wrist by means of a rubber band and two brass clips. The cuff is easily washed

A wet sponge will moisten envelopes effectively, but it soon becomes unsanitary. Here is a moistener made of brass; the handle contains a reservoir and water trickles through to perforations in the blade



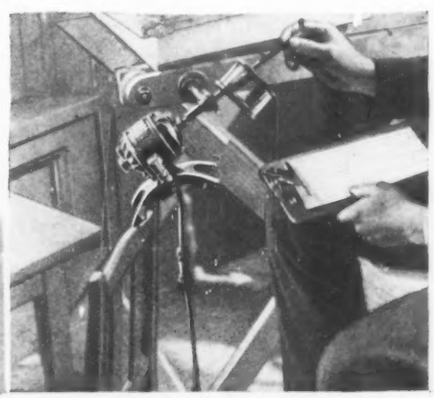
A new typewriter ribbon is passed through this machine and a succession of letters made from a single spot in the ribbon. Thus its endurance is tested

This letter-sealer consists of two metal rollers between which the envelope flap is passed. The lower roller does the moistening; it revolves through a water-trough at the base of the device



Corrugated cardboard, placed in the bottom of a drawer that is used for holding books in an upright position, will prevent the books from slipping when one of them is removed

This memorandum-pad for your telephone consists of a pad, a pencil, a telephone index, and a clip



If you are too lazy to turn the pencil-sharpener, you can attach the sharpener to a small motor so that contact will be made when the pencil is inserted; any sharpener may be used

January, 1921

An Instrument to Warn of Gas Dangers

CARBON-DIOXIDE is a deadly, insidious gas that has neither color nor odor. When considerable amounts of carbon-dioxide are present, the red corpuscles insist on carrying carbon-dioxide through the lungs in place of oxygen. Suffocation results.

Carbon-dioxide is often present in manholes, cellars, wells, smokestacks, and in places where metallurgical operations are carried on.

The device shown above detects the presence of small quantities of the gas. It has a glass tube containing a solid chemical that turns green upon exposure to carbon-dioxide. By comparing the change in color with a color scale at the side of the tube, the percentage of gas present can be determined.

The rubber bulb is for sucking samples of air into the testing-tube.

Singing Lessons for Canaries

MUSIC-TEACHER to canaries is the profession of the lady in the picture, strange as it may seem. Canaries can be taught to sing sweetly as well as young ladies. They are taught by a method of comparison.

Two large tanks, that fit inside each other, are filled with water that acts like compressed air, and with the aid of whistles makes music.

This device whistles a note that the birds like to duplicate. When the birds hear this, they become very ambitious and try to imitate it.

Several weeks' training is sufficient to make a good singer of a young canary with the aid of the compressed-air whistle. Although the canaries make a great noise, those who know claim that it is better than listening to humans learning to sing.

© Kadel & Herbert

© Keystone View Company

How to Keep in Condition

THIS former middleweight wrestling champion, George Bothner, keeps himself in condition by working at an electric vitalizer every morning. While he pulls at the ropes, a current of electricity passes through the handles into his body; the current is supplied by a dry-cell battery.

There are many electrical attachments; one is a metal foot-pad that puts life into tired feet. There is a comb, a brush, and a massaging machine. All of them are easily attached to the battery. The picture above shows Mr. Bothner using the ropes and the foot-pad. The other appliances are hanging on the wall.

This Plug Will Fit Any Socket

UNFORTUNATELY, electric wall sockets are not uniform. Some of them are slotted to receive parallel blades; others call for perpendicular blades; a few are made for T-shaped blades; and some call for blades in line with each other.

But now there is a new plug the blades of which can be turned to fit any of these sockets. These blades are so adjusted that they can be turned by hand, and contact can be made from either side of them. The picture below shows one of these plugs with the blades arranged in parallel formation.

The Brush that Reaches All the Teeth

THE "Bohemian Girl" dreamed that she dwelt in marble halls; and most of us dream either of the beautiful things we want and can't have, or of the ugly things we fear. There is a man, however, who had a vivid dream about a toothbrush—a strange dual toothbrush unlike anything he had seen before.

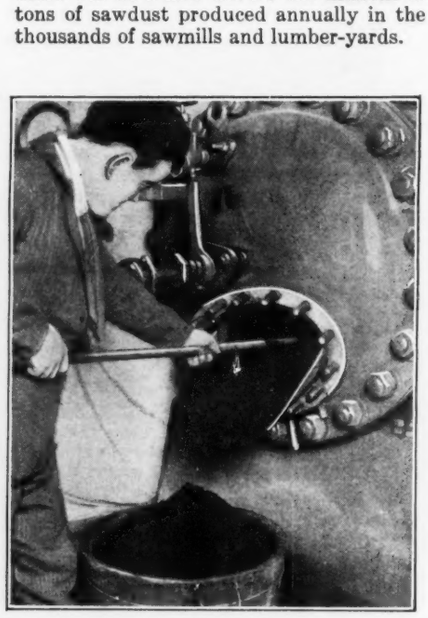
He woke up, made a drawing of it, and went to sleep again. In the morning he looked the drawing over and saw that it was good. Since he was a dentist, he was able soon to have a model made.

There are bristles at each end of the handle, constituting two brushes. One brush is for the outside of the teeth and the other for the inside. Both of them are attached to the brush so that they can rotate slightly. Thus they reach all the hidden corners.

Fodder Made of Sawdust

A GOAT can eat paper, which is but a form of wood. Not so with cattle. However, if experiments now being carried out prove entirely successful, cattle will add sawdust to their diet. Experiments are being made at the Forest Products Laboratory, Madison, Wisconsin, with a new cattle food prepared by treating sawdust with acid.

The sawdust and acid are placed in the long cylinder shown in the picture below. Live steam under pressure is then admitted to the cylinder. This process converts part of the wood into sugar and renders the remainder digestible. A one quarter sawdust ration has been prescribed for the cattle under the test. If they survive, there will be a new use for the millions of tons of sawdust produced annually in the thousands of sawmills and lumber-yards.



Here's Something New in Chimneys

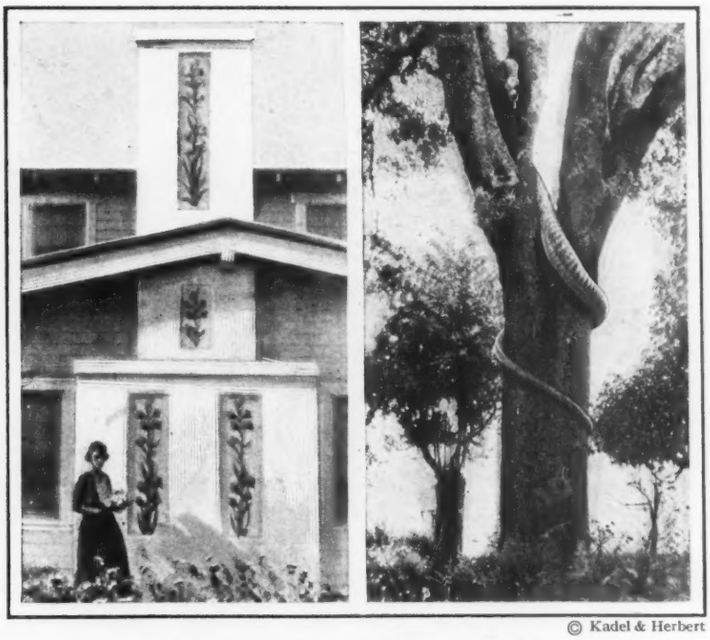
EVERY house must have its chimney; so why not make decorative chimneys instead of the usual undecorative ones?

Take, for example, the chimney shown at the right. It is located at the side of a plain wooden house and is quite the most startling thing in the neighborhood.

This chimney is made of white pressed brick and has four tiled panels in it. Raised flowers decorate these panels and are painted in brilliant colors.

Fortunately, the chimney is well made and the heat is not apt to injure the flowers without. Also it is located in Southern California where the weather is always of the best; thus the paint is likely to remain on for some time.

For ourselves, we are forced to admit that a good old-fashioned chimney of red brick covered with Virginia creeper or some other beautiful vine would seem more attractive than artificial plants of this sort; but the world would be a monotonous place indeed if there were no chance for individual expressions of beauty.



© Kadel & Herbert

To Remind People of Eden's Temptations

THIS snake never did anybody any harm. It is made of rubber. It is not used as a joke, either. It is mounted in a tree of a churchyard at Toluco, Mexico, where it constantly reminds the congregation about the temptations of Adam and Eve.

No one seems to have thought that it might keep the timid away from church.

If Satan ever resided in this snake, he has been knocked out several times, since many people are deceived by it and stop to throw stones to kill it.

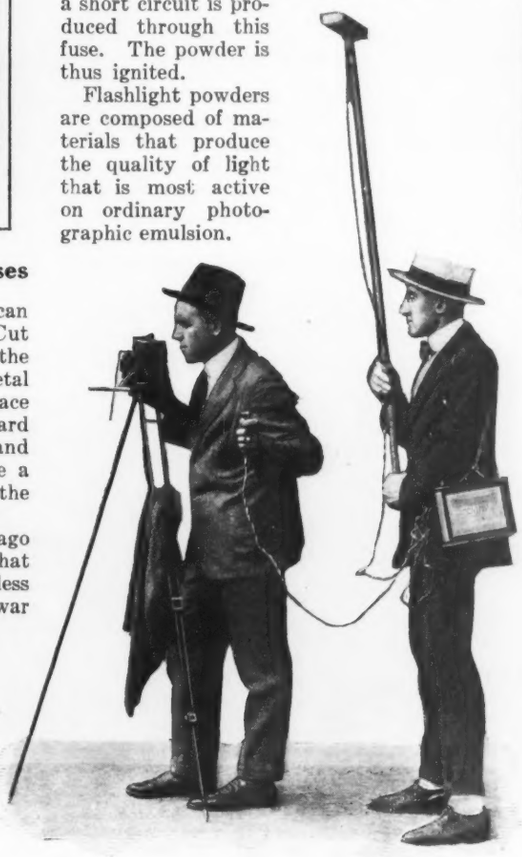
It would not take a Bill Nye to imagine how funny and sheepish a man would feel after he hit this snake with a stone, only to find it was a dummy, and to picture him sneaking away before some one saw him. It would be much like asking a scarecrow for a match.

Whoever put this rubber snake in the tree must have been a snake hunter or an artist, since he arranged the creature in such a realistic manner. This is just how a snake climbs a tree—by twisting its body around the trunk.

Taking Flashlight Photographs Out of Doors

PARADES and night scenes can be photographed by flashlight only when a large charge of powder is employed. To handle this charge requires special precautions. A photographer has devised a way to meet the difficulty by employing a pole eight feet long, on the top of which a metal powder-holder is arranged. A wire is connected with a ten-volt battery carried by the photographer's assistant. A fuse of fine German-silver wire connects the electric poles in the powder-containing device, and when the connection is made, a short circuit is produced through this fuse. The powder is thus ignited.

Flashlight powders are composed of materials that produce the quality of light that is most active on ordinary photographic emulsion.

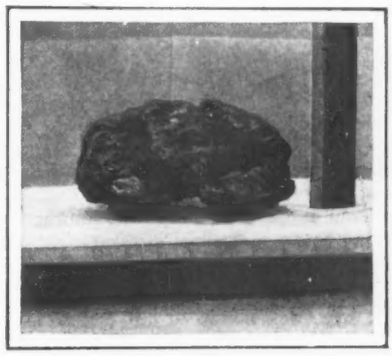


Frames from Automobile Lenses

OLD automobile headlight lenses can be used for framing pictures. Cut down the pictures to suit the size of the glass, and enclose the two in the metal frame that formerly held the lense in place on the car. Next put a piece of cardboard behind the picture to hold it in place and prevent slipping. Then you will have a framed picture ready to be hung on the wall.

The nations of Europe learned long ago to make use of all kinds of materials that have always been considered more or less waste in this country; but with the war the United States learned to save all along the line, from food to iron and steel. The habit was certainly a good one, and now very few people throw scraps of any kind away without surveying them closely with the idea of putting them to some new and useful purpose, which is a good thing for any nation to learn.

Why not get the habit? It will repay you.



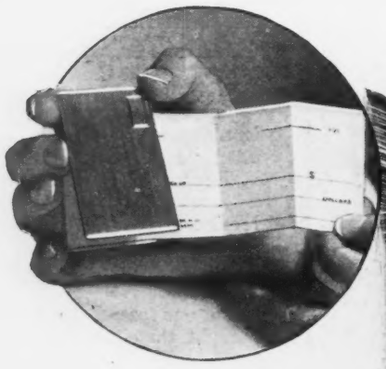
The Twelve-Pound Nugget

A SMALL meteorite—that's what you might naturally think when you look at the object above. It weighs twelve pounds, and measures four by seven inches. It is not a meteorite, however—but a nugget of pure gold. The nugget, which is worth a small fortune, was discovered recently in the Kilo state mines, which are situated in northeastern Congo.

Twenty years ago these mines did not exist.

Prospectors were searching for gold in the Congo, and were assigned to various territories. The man who had charge of the section that now comprises the Kilo state mines reported that there was no gold in his zone, and asked for new territory. He was told to stick to his own zone, and later he "struck it rich."

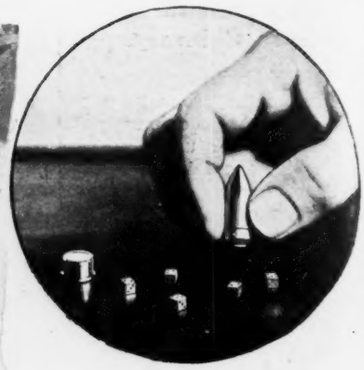
That twelve-pound gold nugget was there all the time.



Is this a Check-Book or a Cigarette-Case?

LET your check-book be worthy of the checks within. If you are a rich man and think nothing of making out four-figure checks, then you should have a check-book of gold trimmed with platinum, like the one shown above. The platinum comes in the form of a name-plate that decorates one corner of the book.

This book of gold is very small—it will hang gracefully from the end of a watch-chain. The blank checks within it must be folded twice before they will fit.



Silver Dice in a Golden Bullet

MEN who like to shake dice can buy tiny cubes of silver. They are so small that five of them can be contained easily in a hollow gold bullet.

The little gold bullet, with its silver dice, makes an attractive ornament for a watch-chain, and if the wearer has heard other bullets whip the air and escaped their sting, perhaps he will have the same good luck with this golden bullet. And that is what a number of players count on—the idea that luck was with them when the greatest stake of all was played for.

Six Miles of Fire-Hose

THE firemen of San Francisco, California, will not be caught napping when a big fire starts in their city. In a recent test of the efficiency of the city's fire-fighting apparatus, 32,000 feet of 2¾- and 2½-inch hose was used by 110 men of the department in demonstrating just what chance they would have with such an equipment.

San Francisco's high-pressure system utilizes the salt water pumped from the bay and stored in an immense reservoir on a hill almost one thousand feet above sea-level. The total pressure available is 314 pounds, but in this test a pressure of only 150 pounds was used. With this reduced pressure the stream was hurled over the city's tallest buildings. Since the great fire, the city has spent more than $20,000,000 to improve its fire-fighting apparatus.

Building a Pyramid of Oil Cake

"WHAT is oil cake? It is a product composed of flaxseed, cottonseed, hempseed, rapeseed, etc., from which the oil has been pressed out. In the jaws of the powerful presses it is compressed into comparatively thin sheets, and is stacked to be sold as food for stock.

Some of the oil cake is used in the garden in place of manure as a blanket of protecting warmth for the hidden germs of plant life.

In the picture women workers of Lancashire, England, are building a pyramid of oil cake. The "cakes" are arranged to permit a free current of air through the pyramid.

An Eighty-Year-Old Dancer

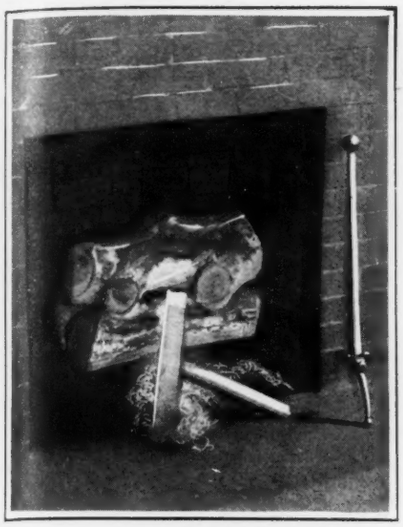
TOO old to get a job, the man in this picture became a beggar—but not the ordinary kind. He gives the public something for their money. Every morning he starts out, wheeling before him a baby-carriage on which is mounted a phonograph. When he reaches a crowded corner, he starts his phonograph and dances to the tune of it.

If the picture below shows an average audience, the old man is given a great deal of encouragement by the passers-by.

True, he is not an expert dancer; but the pathetic picture he makes has won him many a coin. It is to be hoped that the phonograph will not weary of well doing, but that it will cheer the ancient dancer on as long as he lives. He is a German and he dances in Berlin.

© Kadel & Herbert

© Kadel & Herbert



A Gear-Shift-Lever Poker

DON'T sell your battered old automobile to the junkman—use the various parts in your home. The gear-shift lever, for instance, can be used for shifting logs instead of gears. It is strongly made and easily handled; thus it becomes an excellent substitute for a poker. The ball-shaped knob at the top is not affected by the heat of the fire.

The part that is usually hidden below the floor-boards of the car is curved sufficiently to enable you to adjust the logs with ease. Of course, that is quite a step downward for the lever, which formerly played such an important part in the automobile; but who knows what the junkman would have done with it?

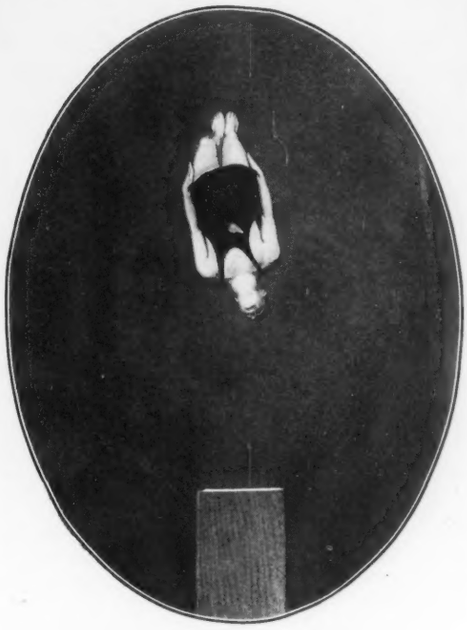
His "Kick to the Moon"

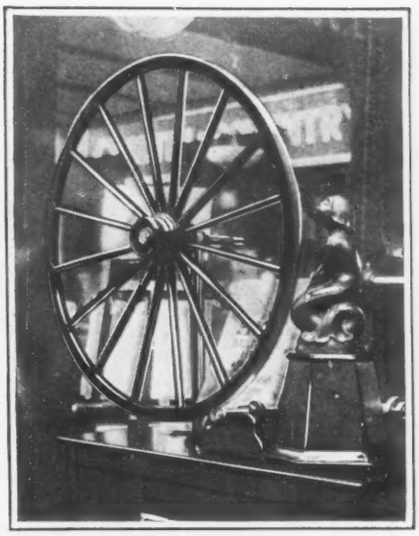
HOW will this man, who has made a somersault from the plank, strike the water?

The art of photography has been the means of analyzing motions that are far too swift to be caught by the eye. When a series of motion-pictures is taken of men jumping, diving, or running, a precise record is made of the sequence of movements.

When these are studied, athletes discover new ways to improve their skill.

This view of the diver, executing a high somersault, called a "kick to the moon," is remarkable because it was taken from such an unusual angle.





She Blows the Wheel Around

THE wheel in the picture above is made to rotate by means of a stream of air which the statue—a Nereid—blows at it. The ball-bearings, rolling in polished races within the wheel, not only facilitate rotation, but they also reduce the amount of friction usually generated by a rotating wheel.

The Nereids are water-nymphs. The one in our picture has been transferred to the land.

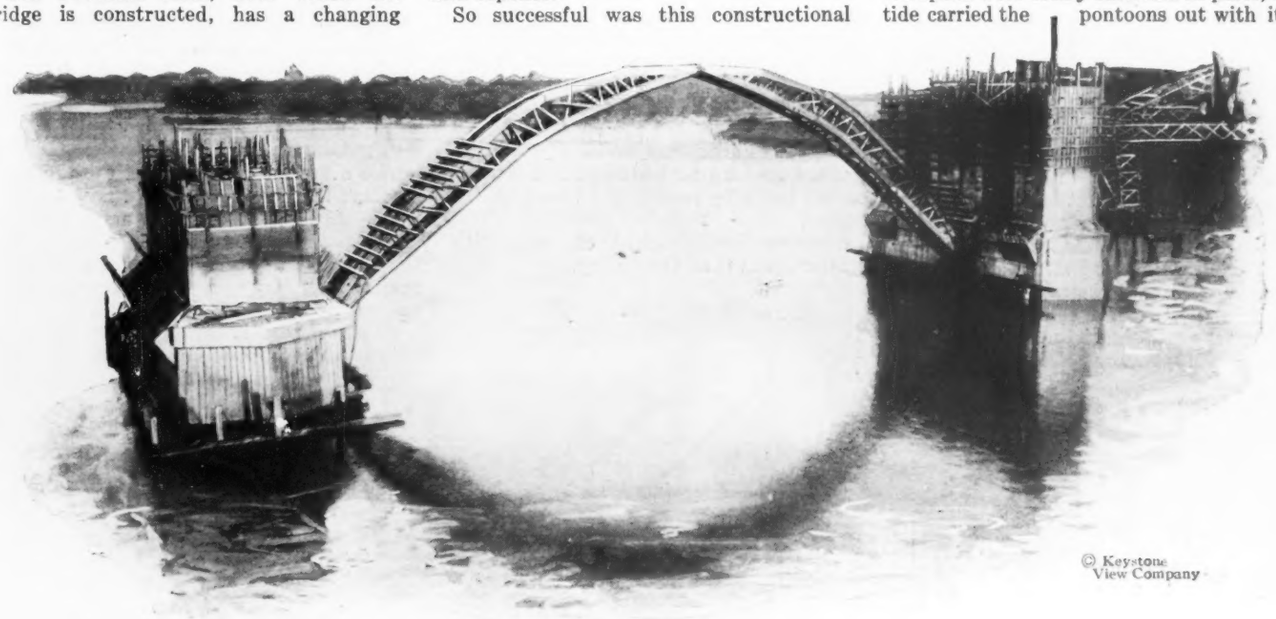
We are familiar with the use of beautiful statuary in connection with fountains in public and house gardens, but utilizing such art objects for purely commercial purposes is new to us. It should not be discouraged; beauty and utility being the almost perfect combination.

How the Tide Helped the Bridge-Builders

THE span of the bridge pictured below weighs more than two hundred tons. The engineers had to put on their thinking-caps when it came to getting it into place. They constructed heavy pontoons and placed the span upon them.

The Potomac river, over which the bridge is constructed, has a changing water-level due to the ocean tides. At high tide the pontoons were floated into place, and as the tide went out, the big arch was gradually lowered into its place. Thus one of nature's forces was put to use and so saved a great deal of extra labor and expense.

So successful was this constructional "stunt" that the engineers in charge of the construction plan to put the other spans of the bridge in place by the same method. When the trick was done, the engineers did not have to wait long for the tide to do its work since it changes every six hours. After the spans were firmly fastened in place, the tide carried the pontoons out with it.



© Keystone View Company

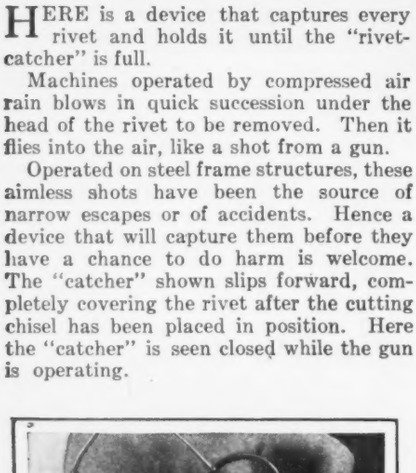
© Central News Photo Service

Trapping the Flying Rivets

HERE is a device that captures every rivet and holds it until the "rivet-catcher" is full.

Machines operated by compressed air rain blows in quick succession under the head of the rivet to be removed. Then it flies into the air, like a shot from a gun.

Operated on steel frame structures, these aimless shots have been the source of narrow escapes or of accidents. Hence a device that will capture them before they have a chance to do harm is welcome. The "catcher" shown slips forward, completely covering the rivet after the cutting chisel has been placed in position. Here the "catcher" is seen closed while the gun is operating.

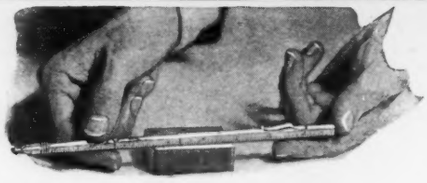


The Little Pocket Atomizer

IT is not always possible to clean eye-glasses with the corner of one's handkerchief when nothing but moisture will remove the particles that have adhered to the glass. The more a man rubs the glass under such conditions, the more likely is he to scratch the lens, and scratches can not be removed without the expense and time for repolishing.

A few "atoms" of moisture from the new atomizer will possibly save the valuable lenses.

Reach into your pocket and take out this diminutive atomizer. It is filled with cleansing liquid, and can be of instant service in removing the dust from the eyes' "window-panes." To try to look through a film of dust is not only injurious to the eyesight but, with this atomizer, is a needless bother.



When a Pencil Turns into a Foot-Rule

A LEAD-PENCIL that can be converted into a foot-rule is a convenient thing to have. The owner has only to give a pull at the opposite ends of the pencil, and its telescoped parts are drawn out to twelve inches.

The pencil-rule is of sterling silver and is fitted with a clip to hold it in the pocket. Another style of this pencil has a clamp that attaches it to the watch-chain.

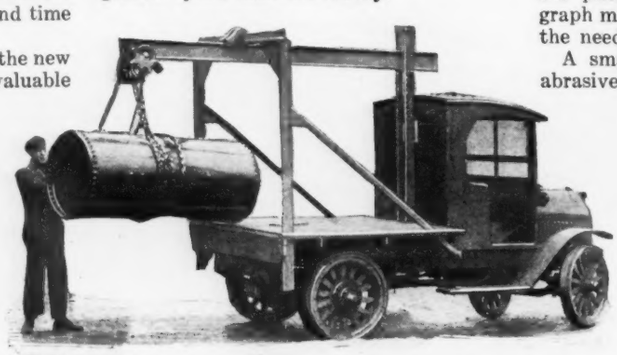
The scale is marked in sixteenths, eighths, and quarters of an inch, with the inches numbered as usual. The lead is held by a silver cap like that of other pencils.

This Truck Carries Its Own Loading Crane

CHICAGO, in the shape of a manufacturer, has come to the relief of the man who loads heavy and clumsy objects on motor-trucks and then tells the boss how he loves his muscle-developing job.

By installing the crane shown in the picture, from five hundred to one thousand pounds of material may be loaded quickly by one man. It is possible to level the beam by an adjusting device at the front end and the load can be locked at any point on the beam by means of a brake on the trolley.

This mechanical giant can run with greater speed than the trolley.

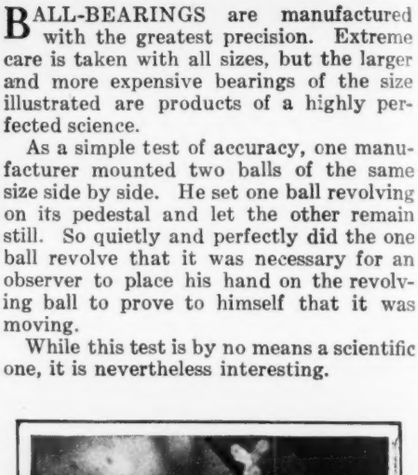


Which Ball Is Stationary?

BALL-BEARINGS are manufactured with the greatest precision. Extreme care is taken with all sizes, but the larger and more expensive bearings of the size illustrated are products of a highly perfected science.

As a simple test of accuracy, one manufacturer mounted two balls of the same size side by side. He set one ball revolving on its pedestal and let the other remain still. So quietly and perfectly did the one ball revolve that it was necessary for an observer to place his hand on the revolving ball to prove to himself that it was moving.

While this test is by no means a scientific one, it is nevertheless interesting.



Sharpening Phonograph Needles

DON'T throw away your steel phonograph needles. Here is a simple device attached to the top of the talking-machine that repoints the old needles. It is a small metal frame with a small drive wheel that runs by friction upon the rim of the phonograph turntable. The phonograph motor may thus play a record or run the needle-sharpener, as desired.

A small tube is arranged to hold the abrasive that both grinds and polishes the point of the needle. The needle is inserted in a hole at the top of the tube, while a small screw at the closed end of the tube enables one to regulate the point, making it rounded or very sharp. A screw holds the "pointer" to the case of the talking-machine, which allows the operator to swing the sharpener against the revolving turntable.

© Keystone View Company.

Messenger-Girls on Skates

IN some large offices errand-girls skim about on roller-skates. Not only do they save time and make more trips, but the work becomes a form of sport and therefore more interesting.

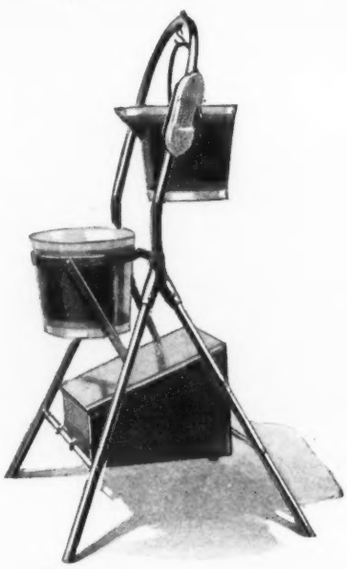
Needless to say, these young ladies on skates would outclass their rivals in a rink, for they have had the abundance of practice that makes perfect.

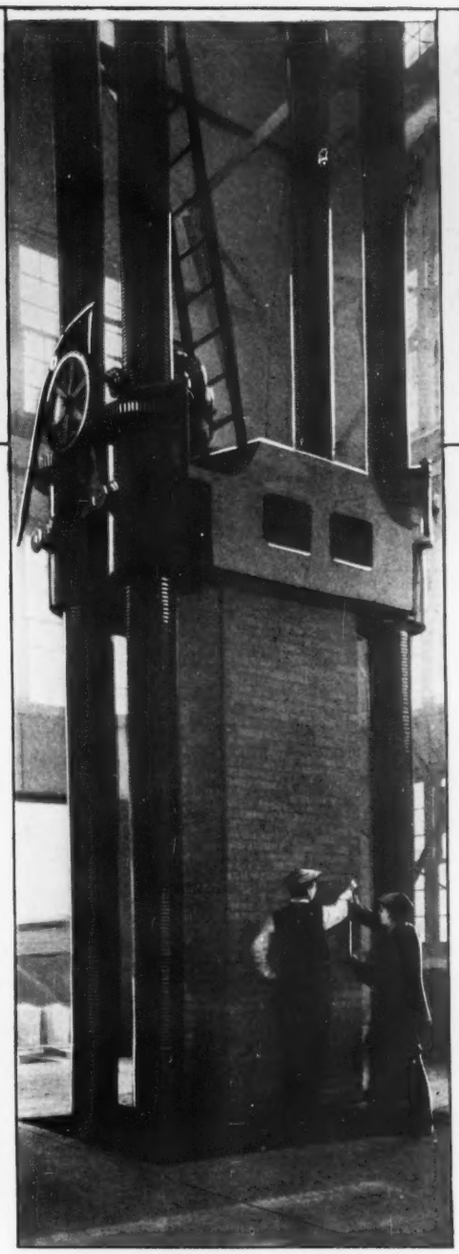
In parts of cities where the traffic is not too heavy, this practice might be adopted by errand-boys and by the messenger-boys carrying telegrams. The boys would then have time to watch new building operations and other interesting things going on in the street.

To Keep the Golf-Balls Clean

THE man who has to clean the golf-balls, after they have become unrecognizable, will appreciate this ball-cleaning apparatus. It consists of a stand made of metal, with a scrubbing-brush and bucket, and a spouting bucket containing fresh water. On the bottom of the stand is a receptacle for wiping-rags that are sometimes thrown on the golf-course.

These stands, which are well and compactly made, are painted to harmonize with the club's colors.





The Crushing Test for Bricks and Concrete

CONCRETE- and brick-testing machines are in use at the Bureau of Standards at Washington, D. C. This giant press can be made to exert a crushing pressure of ten million pounds. This would be equivalent to the weight of at least twenty large locomotives with their tenders.

The sample of brick structure or concrete to be tested is put together under the ram of the machine. The motors are put in operation, and down comes the ram, slowly, but with a terrific crushing force.

After the right degree of pressure for the sample under test has been reached, engineers measure the amount of compression. They are here shown taking a measurement on a column of bricks. Some brick-piles withstand the enormous pressure with very little injury. Others are crushed to dust in the first few minutes of the test. When a pile of bricks gets through the test uninjured, they are good bricks.

Paddling Like a Duck

MAN is distinctly a land creature. When he goes into deep water, he must either sink or swim.

Now, the duck, on the contrary, is perfectly at home in the water.

What is the reason for this difference between man and duck?

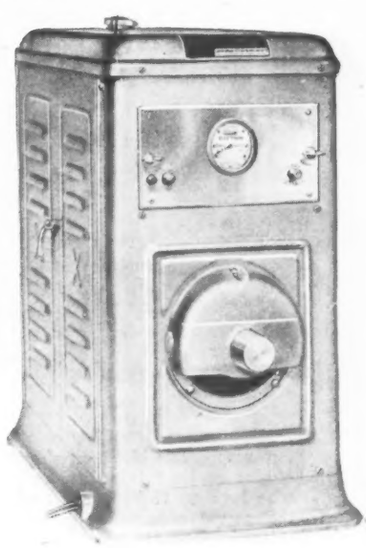
One reason is the duck's webbed feet; they open and shut when he swims, and add to his speed. If man wore a pair of paddles that opened when he struck out in the water and closed when he drew his feet up, could he swim like a duck?

The man in the picture above has annexed a pair of these paddles, and he is practising with them before he attempts a trip to the pool.

An Automatic Power Plant

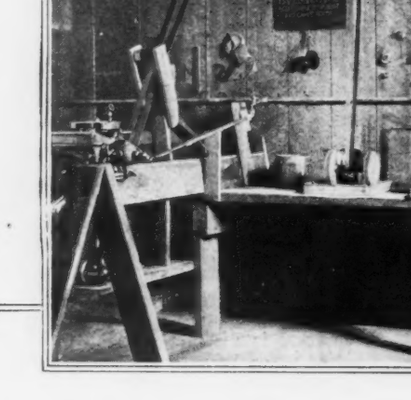
HERE is an electric-lighting outfit for country homes, yachts, or camps. It is placed in a white enameled steel case that hides the unsightly batteries, gasoline engine, generator, and switches. Everything is enclosed, yet the vital parts of the system are accessible should they give trouble in operation.

The fuses and automatic cutouts are mounted on the back of the meter-board. This can be removed like a drawer.

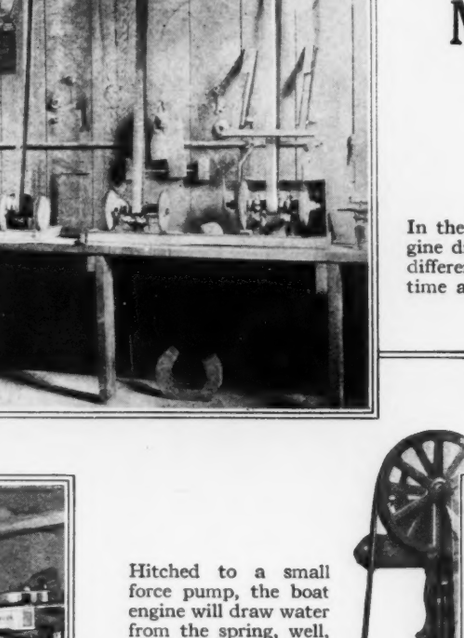


Several New Uses for the Versatile Motor-Boat Engine

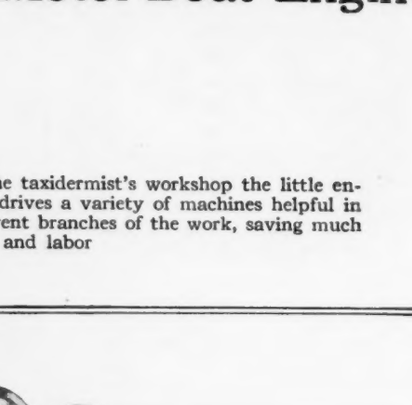
In the taxidermist's workshop the little engine drives a variety of machines helpful in different branches of the work, saving much time and labor



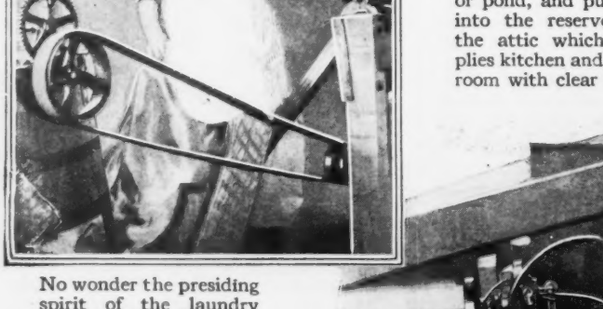
No wonder the presiding spirit of the laundry looks happy. The little motor-boat engine relieves her of all hard work by driving the washing-machine, the wringer, and the dryer



Hitched to a small force pump, the boat engine will draw water from the spring, well, or pond, and pump it into the reservoir in the attic which supplies kitchen and bathroom with clear water



With a little ingenuity the boat engine can be adapted to supply the motive power of a motor-sled which can be built in spare hours and will afford pleasure during the winter months



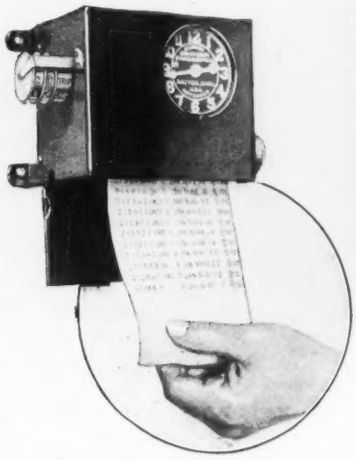
An automobile like that shown here, with the boat engine as its driving power, can be built by boys who love to tinker with tools and machinery. It means valuable training and no end of fun

For strictly practical purposes the little boat engine may also be adapted in many different ways. Here is one that supplies the motive power for driving a circular saw in construction work

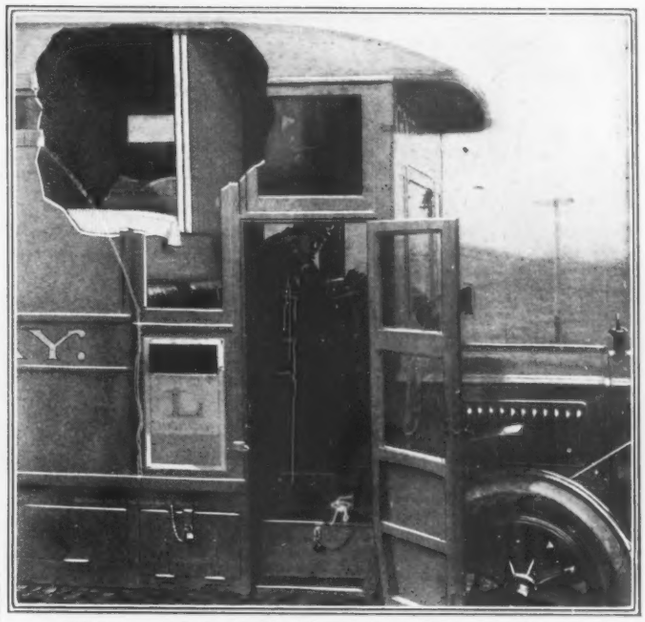
Keeping Tab on a Motor-Truck

A MECHANICAL cost-accountant, recording the expenditures for truck operation in terms of material, time, and distance, has recently been placed on the market by a manufacturer of fare-registers and taximeters.

It weighs seven pounds and is placed on the truck dash. It provides a complete printed record of all details of the truck's work during the day. This record is in condensed form and is proof against tampering, being indelibly printed. It gives the following information: Driver of the truck; date; when the day's work began; how far the truck was driven; the time consumed by each trip; the time of each stop; whether or not the engine was running during the stop; mileage of each trip; number of each trip; weight of each load; when loaded; when and what tires were replaced, if any; when repairs were made; who made them and how long it took; when and how much gasoline was taken on; the average mileage per gallon of gasoline; when and how much oil was taken on; the idle time; number of trips.



This little register gives a condensed and permanent record of the daily performance and work of the motor-truck



While one of the truck-drivers is on duty the other can enjoy a good rest in the built-in bunk

Built-In Bunks for Truck-Drivers

FOR the convenience of their truck-drivers a large manufacturing concern, running trucks regularly between Akron, Ohio, and Boston, had bunks like that shown here built in their trucks. The run of 1500 miles is made on regular schedule in five days and a half all the year round.

It was realized that sleeping quarters must be provided for an extra driver, so the trucks were adapted for this purpose. The result is entirely satisfactory and the drivers get excellent rest while off duty. Entrance is made by climbing on the seat of the driver's cab. The man off duty is ready for any emergency and can step down to the cab at a moment's notice.

Delivering the Goods

BRACING together two motorcycles by means of tie-rods coupled behind a similar machine with a side-car attachment, the man shown below made the trip from Springfield, Massachusetts, to Lima, Ohio.

The idea was originated by a motorcycle dealer of Lima, Ohio, who used it successfully for delivering three side-car machines to purchasers in Lima.

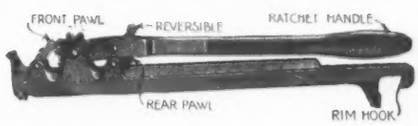
The problem of doing the same thing with the single-track machines presented but little more difficulty. Bars were used to connect two of the machines parallel to each other and one of them was hitched by a towing-yoke to the rear of a side-car machine.

The three machines in this formation were easily handled by one man and were delivered at approximately the same cost as involved in a freight shipment.

The necessary parts for the connections and towing-yoke were made by a blacksmith.

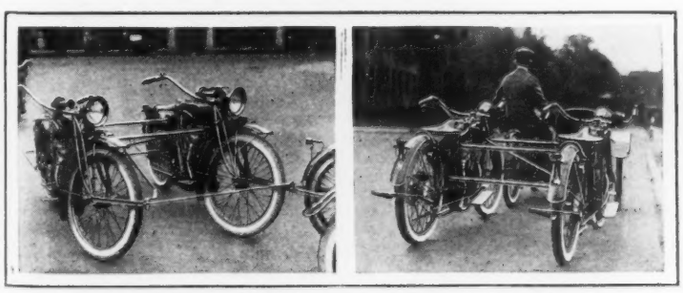
Here is shown a new adjustable rim tool and the method of operating it in making a change of tires

A New Rim Tool that Gives Quick Action



WORKING on the principle of a jack; easy to operate and self-adjustable to any size of tire, the new type of rim tool shown in the accompanying illustrations will enable an amateur to unlock the rim, remove the tire, substitute a new tire, and lock its rim, in five minutes. The tool will fit any kind and size of split rim.

The rim is opened by placing the crossbar of the tool over the rim, with one end near the joint, and moving the handle back and forth a few times. Then the crossbar is placed over the rim with the joint midway between the ends of the tool. The reversible ratchet on the handle is moved to the forward position; the rear pawl engages with the ratchet, while the front pawl is in the neutral position. By working the handle back and forth, the rim may be collapsed to any desired degree and the tire removed. The pawl action is reversed to mount the new tire and lock the rim.

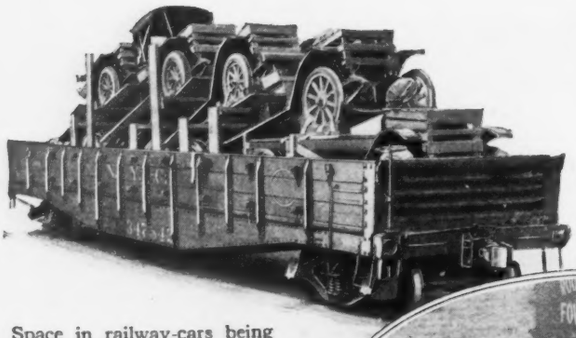


How the towed motorcycles were fastened together by iron braces and the method of hitching them to the towing side-car machine

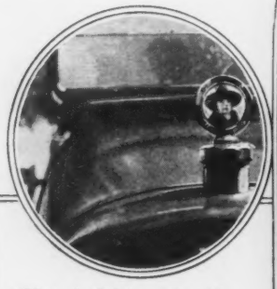
This illustration gives a rear view of the three motorcycles as they appeared on their long journey from Springfield, Massachusetts, to Lima, Ohio

A Big Midwinter Crop

Car owners are sure to find

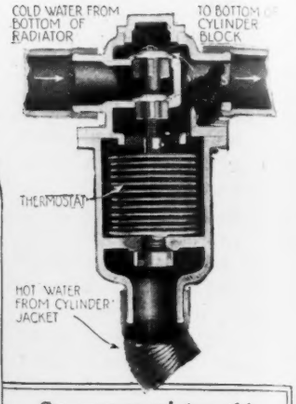


Space in railway-cars being extremely scarce, a manufacturing concern in the Middle West solved the transportation problem by loading five trucks in a car

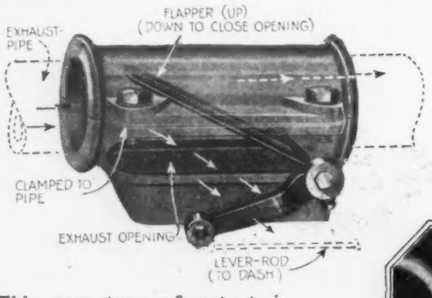


The knights of old wore a glove of their beloved on their helmet as a talisman. Why should not the automobilist carry his best girl's photograph on the motometer?

When your tires need inflating during a winter trip, you will be glad to stop at a garage that has one of these double-service air-supply stands



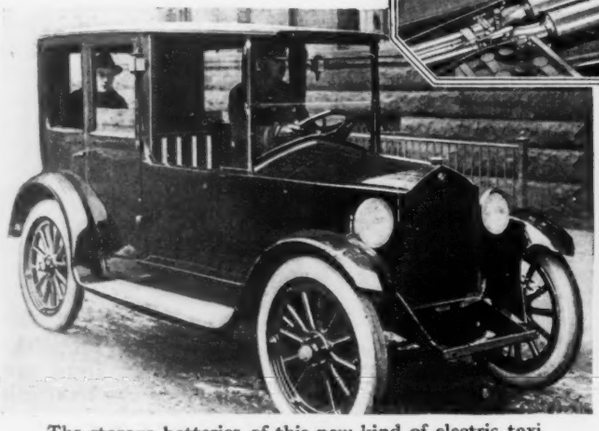
Summer or winter, this simple thermostat, inserted in the pipe between the radiator and the cylinder block, keeps the engine's temperature at its most efficient point for complete fuel combustion



This new type of cutout is clamped and bolted around the exhaust pipe. In the bottom of the pipe a rectangular hole is cut, and the flapper is inserted

Each of the two mufflers shown here takes care of three cylinders and prevents any back pressure on the exhaust stroke of the motor, helping to keep it clean

The magnetic automobile speedometer shown above gives accurate readings under all temperatures. Expansion or contraction of the magnet is compensated for by an automatic thermostatic armature control



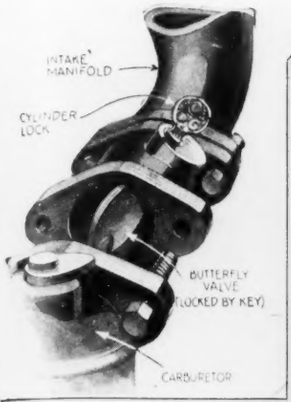
The storage batteries of this new kind of electric taxi are under the radiator and in the space next to the driver's seat. These compartments also accommodate baggage, clothing, and such things

Forget to fill the gasoline-tank? Don't worry; just turn the emergency valve on the heel board of the rear seat, and you can ride from fifteen to twenty miles on the reserve supply

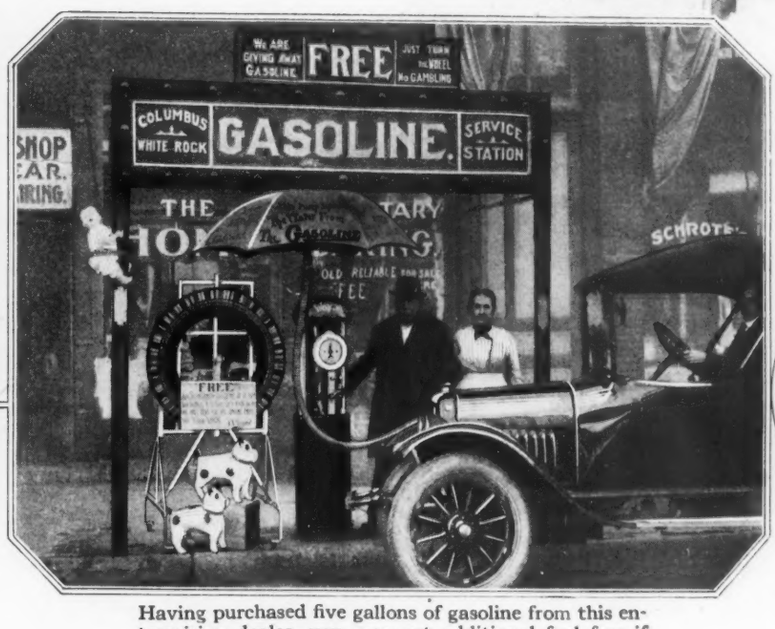
# of New Automobile Ideas

many things of interest here

These mittens are attached to the steering-wheel of the automobile by two pivoted rods in such positions that the driver's hands, slipped in, can grasp and operate the wheel

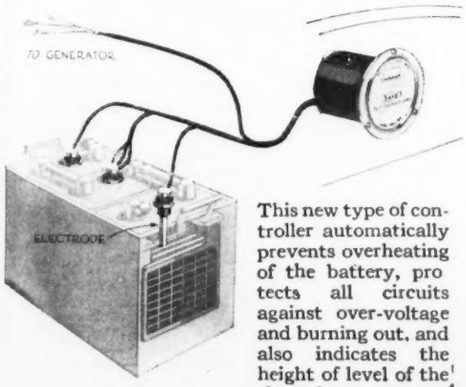


The latest device for preventing the theft of Ford cars is a plunger lock operating a butterfly valve in the intake manifold between the carburetor and the cylinders



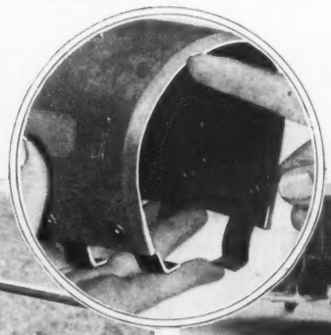
Having purchased five gallons of gasoline from this enterprising dealer, you may get additional fuel free if you are lucky in operating the wheel of fortune

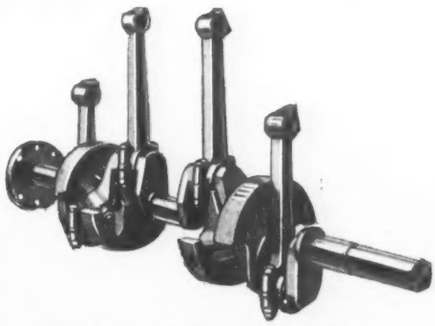
It is a good plan to carry a nail file. In this instance the file is being used to improve the contact of the platinum breaker points



This new type of controller automatically prevents overheating of the battery, protects all circuits against over-voltage and burning out, and also indicates the height of level of the electrolyte

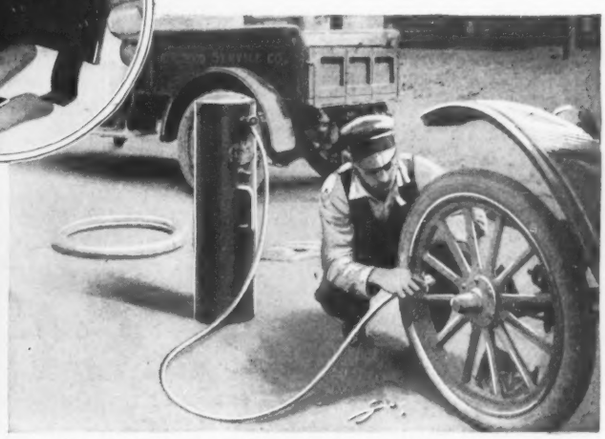
The tire boot shown here does not have to be strapped in place. It is placed over the injured part of the tire and is hooked to the felloe with metal lugs



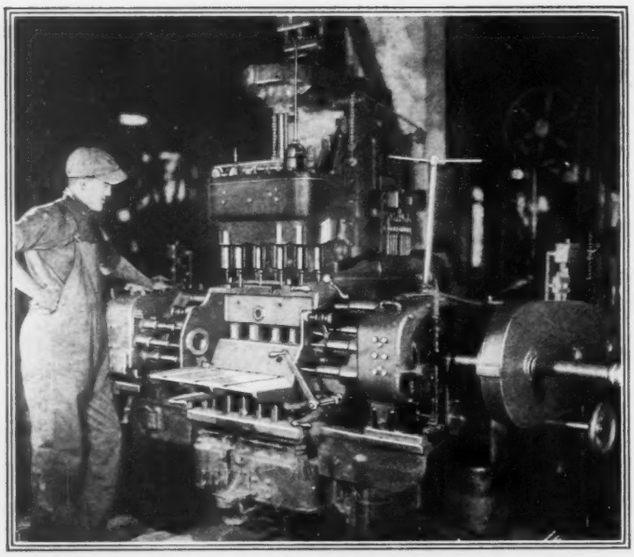


Vibration and friction are the two great foes of every automobile engine. By counterbalancing the crankshaft as shown here, the engine lasts longer

In some of the newest models of American cars the foot-pedal starter is absent. The starting lever has been placed on the instrument board, alongside of the light switch



This portable air-tank, good for a working pressure of two hundred and fifty pounds to the square inch, is far more convenient than a hand pump for inflating tires while touring



In one operation this machine simultaneously drills fifty-four holes in four sides of an automobile cylinder casting

Quantity Production and the Drill

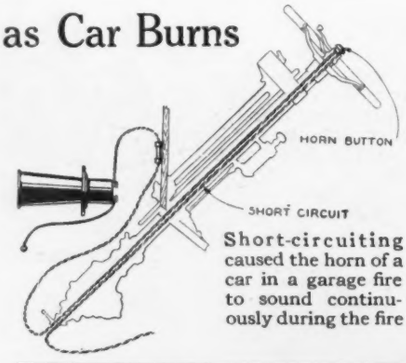
THE machine pictured is drilling fifty-four holes in one operation in the four-cylinder block of a certain make of automobile. In fact, every hole required in the casting is made at the same time.

The operator sets the casting on the table of this remarkable drill, clamps it in place, and the machine does the rest. The drills are simultaneously fed into the work from all sides. The drills on each side are operated collectively from one "head," which encloses a train of gears for revolving each individual drill-spindle. This machine drills the casting in one minute and forty seconds.

The Horn Toots as Car Burns

HOWARD WILL, of Syracuse, New York, lost his automobile in a recent garage fire. While the flames were raging in the building and destroying its valuable contents, the horn of Mr. Will's car blew continually as if it were calling its master or summoning the help of the fire department.

There are two explanations of this peculiar phenomenon possible. The first, that the heat caused the horn button to melt and made a short circuit between the points. The second explanation, which we are inclined to believe correct, is that the heat burned through the insulation of the horn wires, causing a short circuit below the horn button. The diagram illustrates what probably happened in this remarkable case. Whatever the cause, the incident attracted considerable attention.



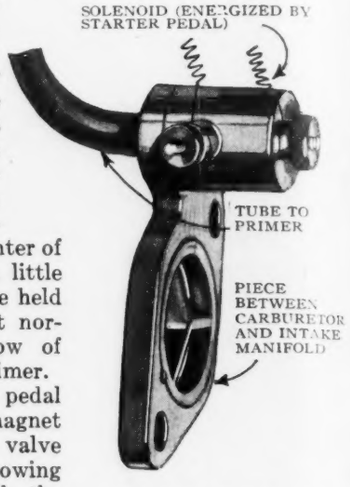
Short-circuiting caused the horn of a car in a garage fire to sound continuously during the fire

Controlling a Primer Electrically

SOME one with real ingenuity has found a way of utilizing an almost negligible part of the electric energy in the storage battery of the automobile to do a big service for the motorist.

He has designed a thin metal piece to go between the manifold flange and the carburetor connection after the manner of a gasket. This piece carries at one side a well-enclosed electro-magnet, connected with the automobile's electrical system. In the center of the solenoid there is a little vertically mounted valve held down by a spring, that normally prevents the flow of gasoline through the primer.

But when the starter pedal is depressed, the electro-magnet is energized, raising the valve from its seat and allowing gasoline to flow through the primer and to spray into the manifold through a hole in the intermediary member. The gasoline is warmed by the heat of the energized solenoid.



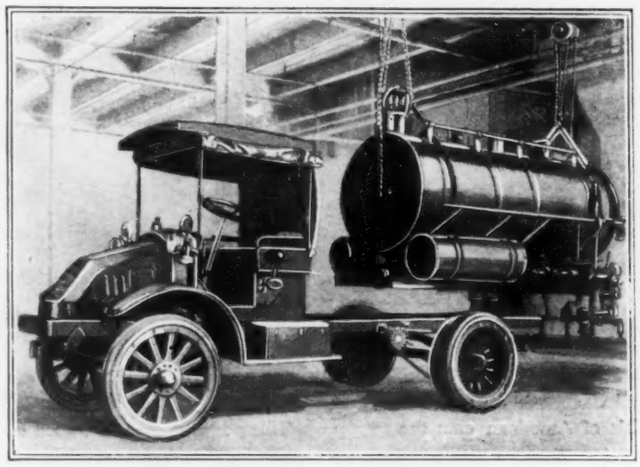
When the starter pedal is depressed an electro-magnet raises the valve and sends warmed gasoline to the primer, all ready for ignition

A Demountable Road-Oiling Tank

WHILE a motor-truck does not eat its head off like a horse when not employed in useful work, the overhead charges of interest on the investment, depreciation, etc., go on just the same. For that reason many road contractors with a comparatively small amount of road oiling to perform have employed horse-drawn equipment.

Now, because but little road-repair work was done during the war, there is more road maintenance and oiling to be done than ever before and contractors who have contracts for road oiling need no longer place their faith in the horse. A Boston manufacturer has put on the market a special oil tank and spraying apparatus which may be removed from the motor-truck chassis in less than half an hour and replaced, when desired, in the same length of time.

The mounting or dismounting may be done without detaching any parts, disconnecting any piping, or in any way disturbing the adjustment of the tank equipment. This is accomplished by mounting the tank and oil-distributing nozzles, and all the piping on a separate subframe, that is attached in turn to the frame of the truck chassis by means of ten bolts. When the nuts are unscrewed, the entire oiling apparatus may be lifted from the chassis by means of blocks and falls and lowered on a platform or trestle until it is again required.



When the road-oiling plant is not needed it can be removed and another body can be substituted in its place

Popular Science Monthly

The Automobile in First-Aid Work

In cases of emergency it will supply material help for medical treatment

The search lamp, with its glass removed, will relieve earache if you place it over the troublesome ear and keep it there

When a tourniquet is needed to stop bleeding from an artery, tie a cloth around the arm or leg and twist it with a wrench or hammer until it is tight enough to stop the circulation

In an emergency a serviceable hot-water bag may be improvised from two feet of inner tubing tied at both ends. The hot water for filling the bag may be obtained from the radiator

Folded side curtains, wound firmly around a broken arm or leg, make a very satisfactory splint in an emergency case. The temporary splint should be fixed with strips of adhesive tape

Broad strips of adhesive plaster or insulation tape should always be in the tool-chest of the car. They will be found useful for bandaging a sprained foot or ankle during a touring-trip

With a flexible shaft, the motor fan, and a camera tripod relief can be given to a fainting person. The shaft is driven by the car engine

This large disk grinder revolves in a horizontal plane and gravity keeps the work pressed against the abrasive surface

Rest the Work on the Grinder

THIS is a disk-grinder used for large work. The steel disk, covered with abrasive paper or cloth, revolves horizontally, and the objects to be ground rest on the surface. It is not necessary to apply any pressure.

A hoist located beside the grinder lifts the work upon the disk. The grinder also has a small suction fan that carries away the metal and abrasive dust. The disk measures fifty-three inches in diameter, weighs eight hundred pounds, and revolves at high speed. The grinder is used especially for surfacing work.

Through Two Looking-Glasses

"WHAT'S up?" you say, as you see a crowd gathering in front of a store window. There you see, besides the usual display of goods, a mirror that reflects charming unseen creatures in the latest creations. Where are the originals? They are up on the floor above. Double reflection, as in the case of the periscope, makes it possible for you to see them.

This is a new "advertising display device" for use where show-window space is limited. It was invented by William Sliter, of San Francisco. The advertiser sets his scene on the second floor where he has plenty of space. Then he adjusts his mirrors to the proper angles.

How can you advertise many goods in a small window? Arrange your goods on the second floor and adjust two mirrors, periscope fashion

The Igloo of the Victoria Land Eskimo

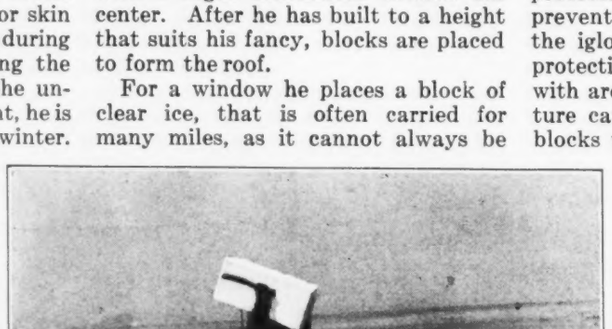
IN the picture the gentleman is not trying to compete with the ice trust. He is providing a place of abode for the long sunless nights of an arctic winter. Having left his tepee, or skin tent, which he had occupied during the short summer months, along the fringe of the barren lands of the unknown northland of our continent, he is now erecting his house for the winter.

The implement in his hand is a copper knife about twelve inches long. The metal for many of his implements he gets from the shores of the Coppermine river, that flows into Coronation gulf, an inlet of the Arctic ocean.

Since he knows nothing about smelting or melting ore, he depends upon a flintlike stone to hammer the virgin metal into the shape he wants.

His copper knife is a utilitarian affair, and is used for many purposes. But most valuable of all is it for cutting snow blocks for his winter headquarters. Blocks from two to three feet long are placed upon one another, with a slight inclination toward the center. After he has built to a height that suits his fancy, blocks are placed to form the roof.

For a window he places a block of clear ice, that is often carried for many miles, as it cannot always be obtained at the place that he selects for his snow house. A small opening is left for an entrance. This is usually protected by a wall of snow blocks to prevent snow from drifting in front of the igloo door, and it also acts as a protection from the winds, which blow with arctic fury. The inside temperature cannot be below freezing or the blocks would melt and the house collapse.



Getting ready for the long, sunless nights of an arctic winter. The Eskimo who is adding an ice block to his house cuts the blocks with a twelve-inch copper knife

Heat is secured by the ignition of seal oil in a small soapstone lamp. Since he prefers uncooked food rather than cooked, even at a temperature of 50 degrees below zero, and sometimes 80 degrees, the question of heat for cooking is of no consideration to him as an item of household comfort.

Since there is no provision for ventilation, and the odor of his sealskin garments withholds nothing in the aggregate of smells, the reader may try to totalize the atmospheric result.

How to Make a Hand- or Power-Driven Blower

By H. H. Parker

THE man with a home shop often feels the need of a small hand- or power-driven blower to operate a forge or blowpipe or perhaps to use as an exhaust fan in connection with a woodworking machine or grinding-wheel or to ventilate a room.

While such blowers are of simple construction, the making of the housing is the source of some difficulty, for if the bearings are integral with the casing, as is usually the case, this must be a casting of substantial construction to withstand the strain and would require a more or less complicated casting. To simplify matters, our method of construction follows the lines of the large "steel plate" blowers, the housing being cut out of galvanized iron and soldered together with the bearing pedestals entirely independent. Two types are shown, a regular blower and one for exhaust purposes, though the latter is adapted to both classes of work.

A 6-in. fan is shown. This size is capable of being driven at about 3000 revolutions per minute by a ⅛ or ⅙ horsepower motor, or it could be hand-driven by removing the grinding-wheel from an ordinary geared grinding-stand, substituting a pulley in its place and belting to the blower. If the power at hand is greater or less than this, it would be better to make an experimental fan wheel, without the housing, and cut down the blades until the motor is able to drive it at the required speed without overheating. The housing could then be proportioned accordingly. A scroll-shaped housing is shown. This is best laid off by dividing a circle into 12 equal parts, remembering that the dividers when set at any given radius will mark off the circumference into 6 equal parts, and these may then be halved. Then lay off a circle representing the diameter of the fan wheel and mark one radius so that it will just clear the outline of the wheel.

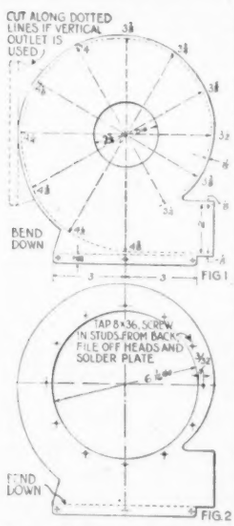

CUT ALONG DOTTED LINES IF VERTICAL OUTLET IS USED
BEND DOWN
FIG.1
TAP 8-36 SCREW IN STUDS FROM BACK FILE OFF HEADS AND SOLDER PLATE
BEND DOWN
FIG.2

Fig. 1: Rear-end housing. Make hole large enough

Fig. 2: Front plate of fan housing

Keep on around the circle, extending each of the eleven remaining radii by an equal amount, and draw a smooth curve through the points. Fig. 1 shows this layoff when using the 6-in. fan, the numbers being the lengths of the radii in inches to the edge of the side casing, the end-plates being extended ⅛ in. all round to allow for soldering the housing together from the outside. The exhaust outlet may be in any position, horizontal or vertical, up or down, by changing the position of the bent-over base strip.

The galvanized iron used should be about 22 or 24 gage or as heavy as could be cut by tinner's snips without great difficulty. While the outline of the two end-plates should be exactly alike, the front one should have an opening cut out large enough to admit the wheel, unless the builder was sure that no further experimenting would be required, in which case the housing might be soldered together after inserting wheel and shaft. An air inlet is cut in the front-plate cover and one of the same size in the back plate for an ordinary blower; the exhaust type should have a hole large enough to admit only the wheel flange. These openings are best cut by drilling a series of small holes with a hand-drill, cutting the piece free with a small cold chisel and finishing the edge with a half-round file.

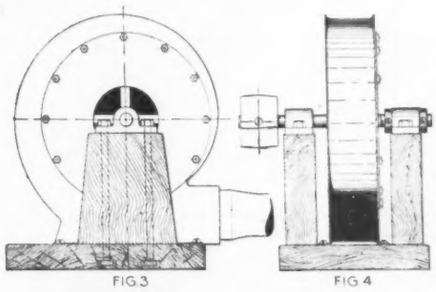


Fig. 3: Side elevation, blower type
Fig. 4: End elevation, blower type

A series of holes are drilled around the edge of the center opening of the front housing plate, Fig. 2, and tapped 8/36-in. Round head 8/36-in. machine screws about ⅛ in. long are then screwed in from the back, the heads filed off flat, and secured by a little solder. These act as studs to hold the cover plate. A paper gasket should be placed between when finally bolting the cover plate in place.

The side of the housing is made of a 2-in. strip of galvanized iron bent around to follow the dotted line of Fig. 1 and the end-plates are soldered to it, taking care to keep the side casing at right angles to the ends and the end-plates parallel to each other. The bottom edges of the end-plates are bent over and drilled for screws which fasten the housing to the hardwood base. See Figs. 3, 4, and 5. A square frame which connects with the blower-pipe is bent up to slip tightly inside of the outlet, Fig. 3, and is soldered to the pipe. If an exhaust blower is built, a round flange is soldered to the cover-plate intake opening for connection to the exhaust line, Fig. 5.

Figures 6 and 7 illustrate two types of fan wheel. The exhaust fan is made by riveting and soldering four galvanized-iron blades to a circular back plate. Then an ordinary round belt pulley, such as is supplied with small electric motors, after having the forward pulley-groove flange filed off, is screwed to the forward face of the disk and provided with a set screw to hold it to the drive shaft.

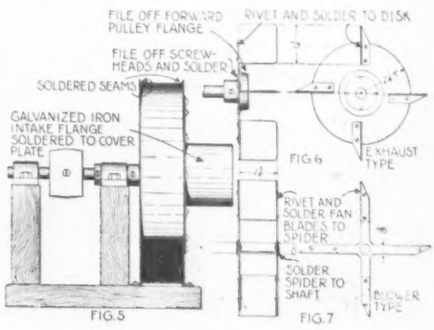
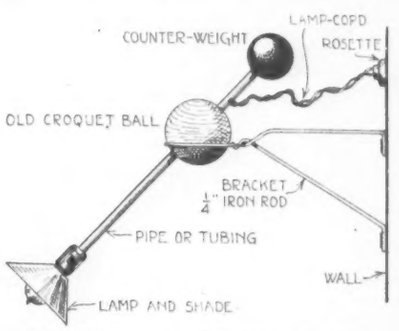


Fig. 5: Side elevation, exhaust type
Fig. 6: Fan wheel, exhaust type
Fig. 7: Fan wheel, blower type

The blower fan is built up without much difficulty by cutting out two spiders from the galvanized iron, drilling them for the shaft, soldering or riveting the blades to the spider arms, and soldering the shaft in place. If the fan is to be driven at a very high speed, the blades ought to be curved *backward*, and if at a relatively low speed, *forward*, to derive the greatest efficiency, but the straight-blade types shown will blow enough for average use.

An Adjustable Bench Light from Odds and Ends

THE illustration shows an electric-light fixture which has been used with great success. It is made from odds and ends picked up around the shop or home, and it is so built that it will stand any amount of hard service. It will throw light in any direction and it stays wherever it is put, as the counterweight on the upper end of the piece of tubing just balances the weight of the lamp at the lower end.—H. M. Kraner.



This light can be shifted to any position and requires no fastening to hold it

January, 1921

A Homemade Bellows for Your Camera

By Ernest Bade

WHEN a photographic camera has been in use for several years, it usually begins to give evidence of its old age. The first sign is almost invariably shown by the bellows, which begin to crack at the creases and develop leaks at the corners. The light coming through these cracks and

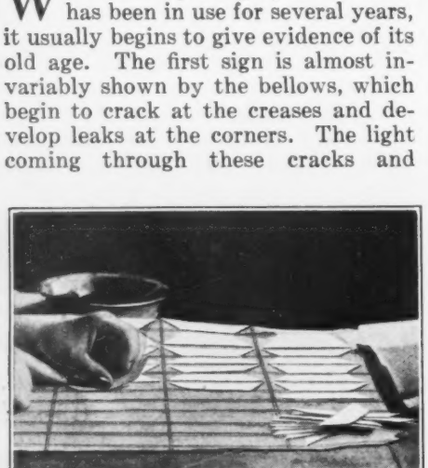


Figure 1 shows the mapping out of the bellows and the manner of pasting down the cardboard strips

holes causes the films or plates exposed in photographing to become "light-struck." For a while judiciously applied patches may extend the life of the camera, but eventually the time will come when new bellows must be put in the place of the old.

New bellows for every standard make of camera may be purchased from the dealers or manufacturers, but in cases of emergency it may be desirable for amateur photographers to make their own bellows rather than risk the delay and expense connected with the purchase of ready-made bellows from the dealer.

The making of bellows which are not tapering but have the same dimensions at both ends is comparatively easy; tapering bellows are a

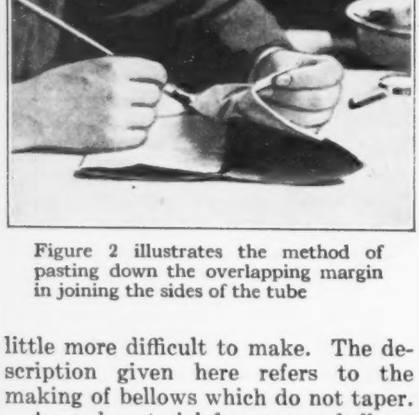


Figure 2 illustrates the method of pasting down the overlapping margin in joining the sides of the tube

little more difficult to make. The description given here refers to the making of bellows which do not taper.

A good material for camera bellows is thin and soft leather, which should be perfectly opaque. If this is not obtainable, or is too expensive, thin, rubber-coated cloth of black or dark brown color may be used. It should have no pinholes or other defects and should be perfectly opaque in all its parts.

First ascertain the dimensions of your old bellows. Place the material for the new bellows on a table or other flat and smooth surface and mark on the unenamelled side of the material the dimensions of the bellows, as shown in Fig. 1. Draw cross-lines at right angles, marking the folds of the bellows. Cut strips of thin cardboard, shaped like those in the picture, and paste them with thin glue on the material, as shown in Fig. 1.

After all strips have been pasted down in the manner indicated, a single sheet of black paper or thin, lightproof cloth is pasted over the material. Then fold the covering of the bellows at the lines marking the height and width, so as to form a tube, and paste the 1-in. margin left on one

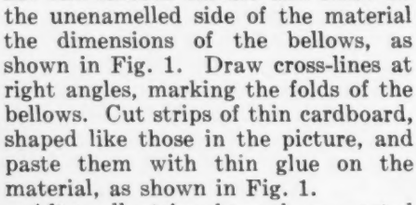


Figure 3 indicates how the bellows should be folded by pressing down the creases with a small ruler

side so that it overlaps the edge of the opposite side, as shown in Fig. 2.

The next step is the folding of the bellows, which is best done with a small ruler, in the manner indicated in Fig. 3. To give to the finished bellows a neat appearance, great care should be taken that the folds are regular in form and all alike on each side. This completes the bellows, which may then be glued to the frame of the camera.

Removing Burnt Oxide from Porcelain Crucibles

CHEMISTS and metallurgists often find it extremely difficult to remove burnt-in metal oxides from porcelain crucibles without injuring them. J. Willard Hershey, professor of chemistry at McPherson College, Kansas, recommends the following method: Fill the crucible about half full of aqua regia and add a few drops of hydrofluoric acid. The relative proportions of the two acids depend on the condition of the crucible.

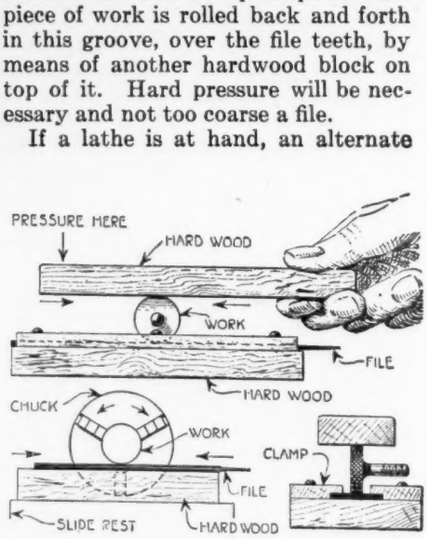
Ordinarily, after standing for five or ten minutes, the crust of oxide becomes loosened and can be washed out with a stream of water. If the crust is very thick, it may take several hours before it becomes loose enough to be washed out. These acids will not affect the crucibles in the least, provided the glaze is not cracked or chipped off.

Chemists who wish to use this method of cleaning their porcelain crucibles should observe the precaution of adding at first not more of the hydrofluoric acid than necessary to loosen the crust of oxide, and to add more only when they find that the acid mixture has not the desired effect.

Extemporized Knurling May Be Done with a File

SOMETIMES it is necessary to knurl the edges of small brass screwheads or nuts when no knurling machine is available. A fairly satisfactory knurl may be put on brass or even soft steel or iron pieces by means of a new sharp file, either straight or cross cut, and some hardwood blocks. One of the illustrations shows how this may be done by hand. The file is placed upon a hardwood block and clamped to it by means of two built-up or grooved strips held by screws or bolts. A narrow groove, about the width of the edge of the piece to be knurled, is left between the two clamp strips and the piece of work is rolled back and forth in this groove, over the file teeth, by means of another hardwood block on top of it. Hard pressure will be necessary and not too coarse a file.

If a lathe is at hand, an alternate



If you have no knurling machine in your shop, you may put a knurl on small brass screwheads by rolling them over a new, sharp file

method would be to place the work in the chuck and mount the file and hardwood block on the cross slide underneath; the block should be of such a height that it and the file will be drawn across the tool slide when the lathe spindle is slowly revolved by pulling on the belt by hand; if necessary, assistance may be furnished by the cross-feed handle.

Such work will not look quite as well as though performed with the regular lathe knurl, but in many cases will answer the purpose when the proper equipment is not conveniently obtainable.—H. H. PARKER.

Drilling Holes through Metal

By H. H. Parker

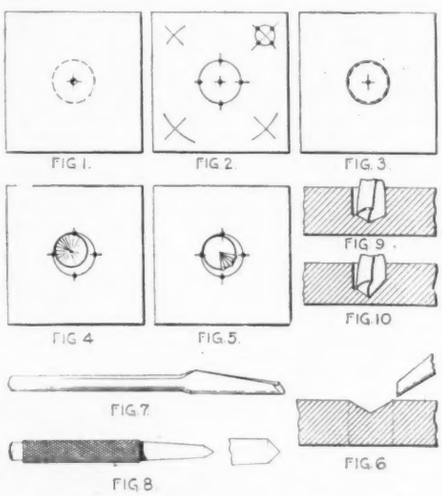
ALTHOUGH about the first thing the machine-shop man learns to do, perhaps a few words to the automobile owner or home mechanic who is installing a small drill-press may not be out of place. Of course it is easy enough to make a dent in a piece of metal with a center punch and drill a hole through the piece, but whether the drill follows the punch mark or runs off a sixteenth of an inch or so, is a question of luck to a great extent, unless the drill is perfectly sharpened and the drill-press in good shape—even so, a large drill will seldom follow the punch mark exactly.

It is a good plan first to drill a small hole as shown in Fig. 1 and then follow up with the large drill; it is much easier to get a small drill through accurately and the large one will usually follow the small hole. This also causes less strain on the large drill, for the small hole relieves the point of the drill, which never cuts efficiently and has to force its way through the metal.

To be sure the drill will go through in the right place, however, a small prick mark should first be made at the center of the desired hole and a circle, the same diameter of the drill to be used, scribed around it (Fig. 2). Then make four prick marks 90° apart on this scribed circle, as shown. If the metal surface is chalked first, or, in the case of very fine work, coppered or blued, the scribed lines and marks will show up much plainer. Now drill the small pilot hole and start the larger drill, but withdraw it before the body part has started to enter the hole—for the first trial, when the point is not over a third of its way in. In all probability the beginning of the hole will appear as in Fig. 4—off center. This should cause the operator no concern, for he can now proceed to "draw over" the drill. A small chisel with a narrow rounded point like Fig. 7 should be provided and a groove or a series of grooves, if the drill is badly off center, is chiseled down that side of the cavity nearest the center of the required hole, as in Fig. 5. The size of the groove or the number of grooves needed must be found by practice; if too much metal is cut away, the drill will run off on that side; but if the groove was made too small, it will not draw back enough. Several trials may be necessary to get the drill-point centered, but this must be done before the body of the drill enters the hole, for after this happens, it will be almost impossible to draw the drill over any more.

If the drill cuts into all four of the prick marks, it is well centered. Another method is to scribe a circle a little larger in diameter than the required hole, as shown in Fig. 3, without making the prick marks around the edge; then if the drill enters accurately, the scribed circle will just be visible entirely around the hole.

Figure 8 shows the difference between a prick and center punch; the former has the sharper point, from 45° to 60°, while the center punch has a blunter point of about 90°. The prick punch is used for the preliminary laying off, as the marks may be more accurately made, while the center punch makes the final indentation for starting the drill.



Ten illustrations are here given which clearly explain the best method of drilling through metal, true to mark

While the subject will not be discussed here, the correct grinding of a drill is of great importance; Figure 9 shows a drill with its lips ground wrongly, one being longer than the other; in Fig. 10 the angles of the lips are unequal, the result being in each case that the hole, besides being off center, will be larger than the actual diameter of the drill, the defective grinding causing it to "wabble."

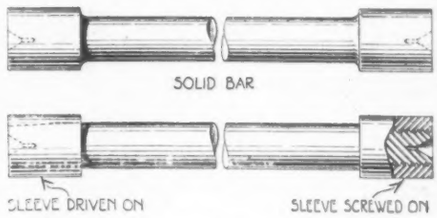
In regard to lubrication, though it is always necessary to apply oil or lubricating compound to a drill when working on steel or wrought iron, cast iron is drilled dry. Brass is usually drilled without lubrication, but it is customary when working with this metal, as well as copper, to grind off the sharp edges of the drill lips, merely touching the edges to the wheel so that no appreciable amount of the edge will be removed.

This expedient will prevent the drill catching when it breaks through; if this precaution is not taken, the operator will have good reason to remember it next time if he happens to be holding the work when the drill point comes through and the piece starts to whirl around in his hands. This often causes painful lacerations of the skin, which may become infected and lead to a serious case of blood-poisoning.

An Improved Bar for Lathe-Testing

IN testing a lathe for the parallelism of its cut, it is customary to make up a steel test bar such as shown in the illustration. A very light cut is taken off each end and the ends are then calipered. After considerable usage, the enlarged ends are finally turned down to the diameter of the center portion of the bar and the whole then becomes useless, requiring the scrapping of a piece of good steel.

When turning up a new test bar, or making over the old one, the ends can be turned down smaller than the center portion, forming shoulders, then either turned taper or threaded. Two sleeves are then turned to a larger outside diameter than the bar and fitted to the ends; as the test cuts are light, the sleeves do not need to be driven or screwed on very tightly. When the diameter of the ends is reduced to that of the center of the bar, they are removed and new sleeves fitted. The illustration shows a bar, one end of which has a sleeve screwed on, while the other is driven on to a taper fit.—H. H. Parker.

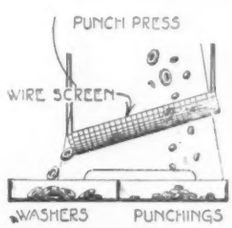


When the sleeves of this lathe-testing bar are completely turned down, new ones can be put in their place

Use a Screen for Sifting Out the Punchings

HERE is a simple yet effective method of separating the punchings from the product in punching washers on a press.

Take a wire mesh screen and place it at the rear of the punch press as shown. Place two boxes underneath, one box directly underneath the punch, the other in the position shown.



Can you imagine a simpler method of separating the punchings from the finished product?

Down comes the punch, and out drop both the washer and the punching, but the punching falls through the screen into one box, while the washer travels down until it slides into the other box. This saves time and money to any one who does an appreciable amount of punching.—J. H. Moore.

"Hexa"—More Powerful than TNT

By Graser Schornstheimer

BECAUSE little has been said about them, one should not suppose that Germany had no inventions of military importance during the war. It was particularly necessary to discover an explosive that would give greater efficiency to her torpedoes. Hexa-nitrodiphenylsulphide was the result. This explosive, known in the German navy as *hexa*, has an explosive energy ten per cent greater than that of TNT, and thirty per cent greater than that of wet guncotton. Also, it is said to be as safely handled as TNT.

In the war heads of the torpedoes it was mixed with wet guncotton to give that weapon greater power, and to some extent it was mixed with TNT. In the case of the 19.7-inch torpedo, which was carried by nearly all the German submarines, it was thus used.

When mixed with wet guncotton the total charge was 430 pounds, but when it was used with TNT, the charge was only 330 pounds. It would be difficult to say which of the two charges was the more efficient, but it is plain to be seen that weight and space were saved in the torpedoes by the introduction of this explosive. This was exactly what was needed. The charges of the torpedoes were always sufficient to destroy the ships at which they were aimed, but the range of the torpedo was entirely insufficient, and at the extreme ranges the torpedo was so slow as to make it fairly easy for even a slow ship to dodge them.

After this new explosive was introduced, the famous 19.7-in. torpedo was redesigned. The length became 22.97 feet. The range was lengthened by the additional space that it was possible to give to the machinery. Up to 5500 yards the speed is thirty-five knots, and at 11,700 yards the speed is twenty-eight knots; or, to put it in different words, at six miles the speed is still about thirty land miles an hour.

In all the larger ships, after the battle-cruiser *Lützow*, an entirely new and very large torpedo was used. It was built to take the war model torpedo—23.6 inches in diameter, the largest used in any service. The war head of this torpedo contains a charge of 550 pounds of explosive, and it combines the greatest explosive energy possible in a torpedo, with the maximum speed at long ranges, for at a range of eight miles the speed is still thirty land miles an hour.

The double torpedo tubes for this torpedo, which were fitted to the later flotilla leaders in addition to their four 5.9-inch guns, were so heavy that they had to be handled by electric handling motors on the decks. It is easy to see why the Germans complained that these boats were top-heavy and that they rolled badly even in a moderate sea.

It has been said that the greatest share of German naval attention was directed to the torpedo service rather than to the training of the gunnery personnel; in fact, some German naval officers charge that gunnery was neglected. This may, in some measure, explain the reason for the failure of the Germans to register hits upon the British after the first few minutes of the battle of Jutland.

How Two Boys Made a Motor-Sled

By C. H. Thomas

THE motor-sled shown in one of the pictures and of which details of construction are given, was built by the two boys sitting on the sled, William H. and L. F. Mowery, of Kennett Square, Pennsylvania. This unusual craft was used by them last winter with excellent success and attracted considerable attention. On their rides over the icy streets and roads in and around their home town, the boys often attained a speed of twenty miles an hour. They found that they could run about seventy-five miles on one gallon of gasoline.

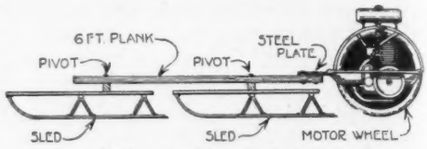
With this motor-sled its builders can make a speed of twenty miles an hour

The motor-sled is made of two flexible steel guider sleds joined together by an oak plank, 13 in. wide, 1¼ in. thick, and 6 ft. long. The plank is attached to the rear bob with two bolts, each ⅜ in. in diameter. It is raised about 1½ in. from the platform of the sled to give to the sled more freedom in following the irregularities of the ground.

The front end of the connecting plank is pivoted to a cross-piece, ½ in. wide, ¾ in. thick, and 2 ft. 6 in. long, which is screwed to the sled and serves for steering with the feet.

A steel plate, 3 in. wide, 1 in. thick, and 10 in. long, is securely bolted to the rear end of the plank with three ⅜-in. bolts. To this plate the motor-wheel is fastened. The connecting-shaft of the motor passes edgewise through the steel plate.

The controls are similar to those used on a bicycle and are fastened on



Two sleds, an engine, and a plank are the main components of this motor-sled

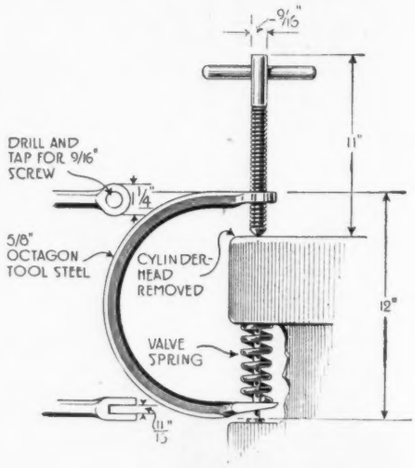
two pieces of pipe, ¾ in. in diameter, which are bolted to the plank by two stud bolts.

When winter is over, the motor-wheel can be disconnected from the sleds and again attached to a bicycle to supply it with motive power during the summer.

A Valve-Spring Compressor Made from Tool Steel

NUMEROUS as are the clamps that have been designed for compressing the valve-springs of automobile engines, another one of extremely simple construction may be added. It is made of octagonal tool steel, ⅝ in. thick.

The steel rod is bent as shown in the accompanying illustration. One end is flattened and the flattened part



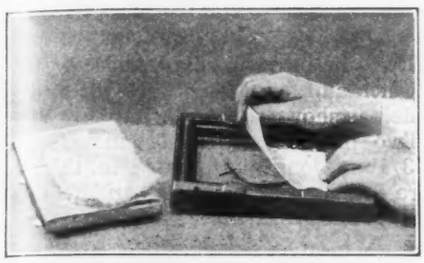
This valve-spring compressor was made of octagonal tool steel

drilled and tapped for a 9/16-in. screw. The other end is also flattened, but is cut so as to form a fork large enough to pass over the valve-stem. The required dimensions are given in the drawing.

When the compressor is to be used, the 11-in. screw is unscrewed far enough that the fork of the tool can engage the valve-stem below the spring while the screw rests on the valve-head. When the screw is now tightened, the spring will be compressed, while the valve-stem will be held in place. After the spring has been compressed sufficiently, the pin may be drawn from the stem and the valve removed.

How to Photograph Leaves without a Camera

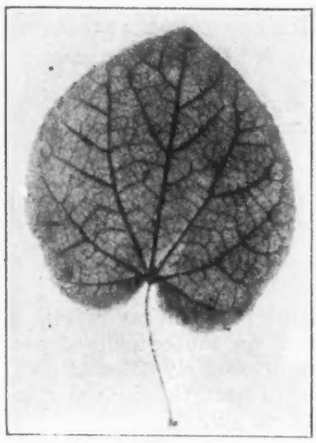
WHENEVER you wish to make prints from leaves, take the printing-frame, place the leaf upon the glass, and lay a bromide paper with the



Leaves may be photographed by printing direct from them on sensitized paper

sensitized side upon the leaf. Then take a little cotton and place on the back of the paper. This presses the paper gently against the leaf.

Expose like any other negative and develop. It will be a leaf negative



Prints made in this manner show every detail of the structure of the leaves

and show every vein and veinlet. When positives are required, use glass plates. Make the negative as described and from this negative make a print, the positive.—E. BADE.

A Bottle-Capping Machine Made at Home

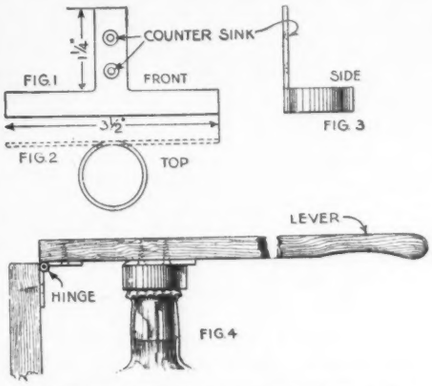
HOUSEWIVES and others who have many empty vinegar and soft-drink bottles, and who wish to put up various sorts of fruit-juices, etc., will find this capper to be "just what they have been looking for." Many have any number of empty bottles, and can purchase the caps at nominal figures, but hesitate to pay the prices asked for capping-machines. This one can be made at home or by any tinner at a trifling cost.

The illustration shows exactly how it is made. Figure 1 is a piece of sheet steel or other metal stout enough to stand the strain for which it is to be used. Cut hot, or cold, with cold chisel, as per dimensions given in diagram. Also bore or punch two small holes at the top.

Figure 2 shows how the lower part is bent in the form of a circle to fit the top of the cap.

Figure 3 is a side view and shows how the upper arm is bent to attach to the handle. Figure 4 is the top portion of the machine as completed.

The handle, of course, can be made of wood of almost any sort and size, if it has the required strength, and is attached to a piece of wood, which in



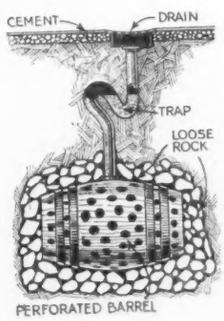
Pressing down the lever will fasten the metal cap around the mouth of the bottle

turn may be secured to a table or whatever you use for holding the bottles while capping. Merely fasten with a hinge, as shown.—G. A.

Improvised Drainage for a Suburban Garage

ONE of the problems for the builder of the suburban garage where drainage facilities are not present is that of disposing of oil, dirty water, mud, etc., when the car is washed or the chassis and engine cleaned with kerosene, the radiator drained, etc.

An inexpensive solution of this problem is shown in the accompanying sketch. This consists of an old tank or steel cask with perforations in the sides buried in loose rock about four feet underground.



This perforated barrel insures drainage from your garage

This is connected with the drain in the center of the garage floor by a piece of bent pipe. The bend in the pipe is S shaped, and it acts as a vent check, preventing the odor from the underground tank from returning to the garage. An old metal oil or tar barrel is suitable for this purpose and will last for an indefinite time when it is buried in the loose rock. Make sufficient holes or openings in the barrel before it is buried to allow for seepage.

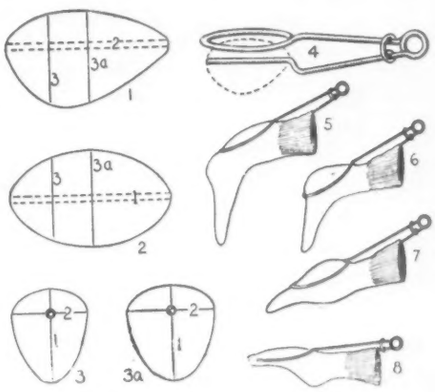
A Stocking-Darner that Is Easily Adjusted

THE clamp principle of this darner is not new, though its details are somewhat improved. The novelty lies in the shape of the ball and its adjustability to the clamp, giving a much

The stocking-darner and the wire holder which holds the material in position

greater range of convenience, also allowing the ball to be removed entirely from the clamp.

Figures 1, 2, 3, and 3*a* give the three cross-sections of the ball, the numbered lines on each giving the plane of the section bearing the same number. Length of ball, 3½ in., width 2½ in., depth about the same as width, or a



Ways of using the darner for mending holes in various parts of the stocking

little less. The flattened upper side (see 1 and 3) serves for leg and other flat darning. The humped lower side (1 and 3), swung around and brought under the clamp, is handy for the point and back of heels, and by reversing the ball, end for end, slim end out, this humped side serves equally well for the under side of heels, while the slim end is for toe darning.

The clamp is made of medium stiff spring wire. Figure 4 will make clear its construction. The loop at the end, which serves to clamp the work, should be made to fit as closely as possible the outline of plane 2.

The remaining diagrams illustrate the darner's use on various parts of the stocking.—CHARLES A. PEASE.

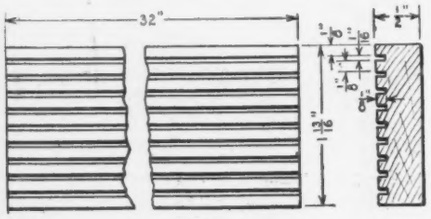
Keep Your Phonograph Records in Order

By Theron P. Foote

AMONG the numerous makes of phonographs there are many of the cabinet style which have shelves on which to keep an abundant supply of records. One oftentimes desires to find a certain record, and unless some efficient means of filing and indexing is employed, it is a rather tedious and confusing job.

The following method has been very satisfactorily used and it takes but a short time to manufacture.

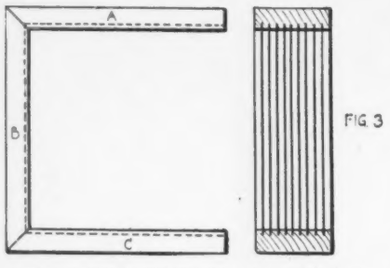
At a carpenter shop have as many strips as you have shelves cut as shown



Strips of the dimensions given are first grooved, as shown in Fig. 1; then mitered, as indicated in Fig. 2

in the illustration, Fig. 1. The width of the strip should be ¼ in. shorter than the distance between shelves in your phonograph cabinet, that is, as in my cabinet, the distance between shelves is 2⅛ in., so I had strips cut to 1 13/16 in., thus allowing 1/16 in. for variation. Grooves made by a circular saw of 1/16-in. thickness and adjusted to a depth of ⅛ in. were cut lengthwise of the strips, approximately ⅛ in. apart. The strips were then cut into three parts, as shown in Fig. 2, and assembled, as shown in Fig. 3.

By the use of material ⅛ in. thick and 12½ in. square, placed on the top and bottom of the form shown in Fig. 3 and securely fastened (using either nails or flat-head screws to be countersunk), the form is made more



The mitered strips are assembled as shown here. There should be one of them for each shelf of the cabinet

solid and durable. See Fig. 4. The front ends of parts *A* and *C* should be flush with the edge of the ⅛-in. material.

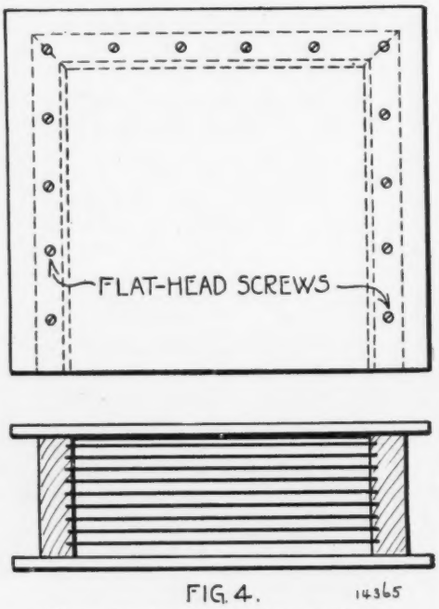
Before assembling *B* is laid on a

With this record-finder placed in your cabinet you will find it easy to locate and extract any record disk desired

drill-press and using a No. 36 drill (.106 in.), holes are drilled all the way through as shown in Fig. 5. Note that the holes do not touch the grooves but are in the center of the ridges made by the grooves.

Five-inch lengths of 3/32-in. spring steel, each having a small hole in one end, were tacked on the ⅛-in. ridges between grooves and in such a position that the free ends overlapped the hole by about 1 in. See Fig. 5.

Using a drill-rod of slightly smaller diameter than the hole, or about 3/32



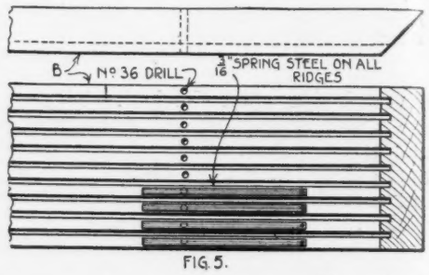
These drawings give an idea of the appearance of the assembled unit for one of the shelves, top and side view

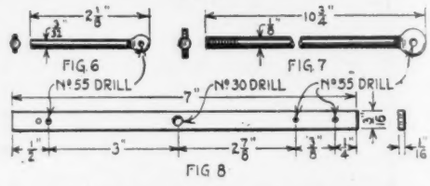
in. thick (.0937 in.), cut into as many pieces as there are grooves, each piece being about 2⅛ in. long, and flatten one end. With a No. 55 or smaller drill, make a hole through the center of the flattened portion. See Fig. 6.

One-eighth-inch drill-rod in as many pieces as there are grooves and cut into 10¾-in. lengths, is threaded on one end and flattened on the other. The thread on the rods is just long enough so that when terminals which come off from dry-cell batteries are screwed on the end of the rod the thread will be just flush with the top of the terminal. Through the flattened end drill a hole with a No. 55 or smaller drill. See Fig. 7.

Strips of brass 3/16 in. wide, 1/16 in. thick and 7 in. long were cut and drilled as shown in Fig. 8.

Two blocks of wood 1⅛ in. wide, 1 13/16 in. long and about 1 in. thick were drilled with a No. 25 drill (.149 in.), as shown in Fig. 9. They were



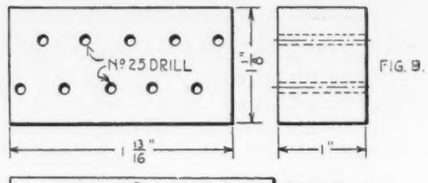


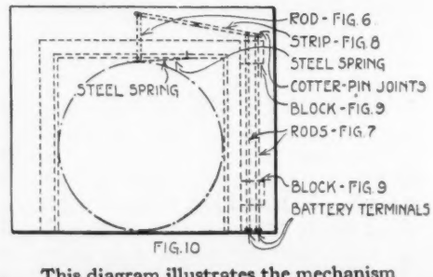
Additional detail of the locating device constructed according to the specifications given is shown in Figs. 5 to 8

then mounted by means of glue and small brads on the outside of part *C* —one approximately 2 in. from the front end of part *C*, the other to be flush with part *B*.

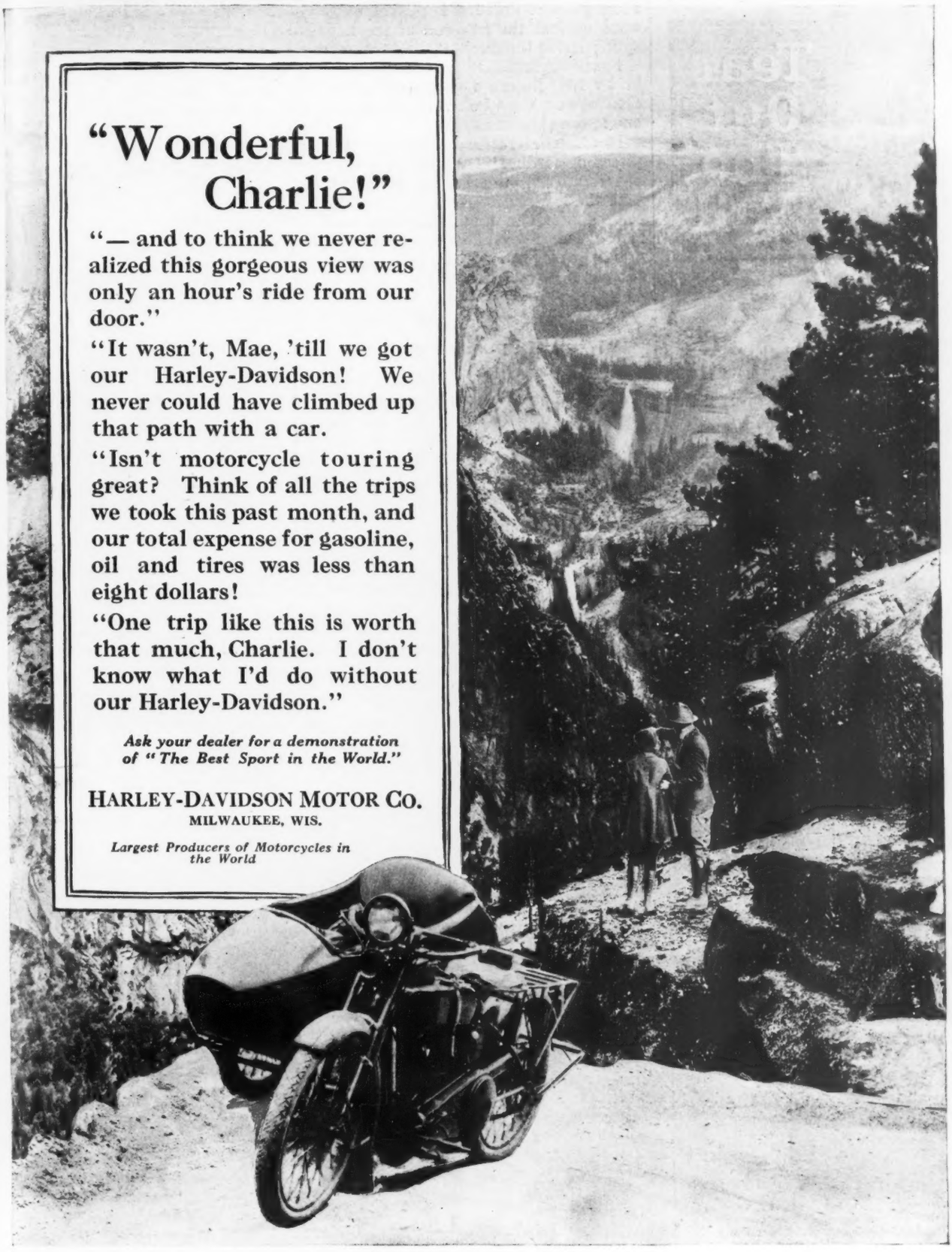
The rods were then mounted in place and connected to the brass strips by means of small cotter-pins. See Fig. 10.

A piece of ⅛-in. drill-rod passes through the holes (drilled with No. 30 drill) in the brass strips and through the ⅛-in. material extending in back of part *B* and holding the form together, thus acting as a pivot or axis for the brass strips. Thus if the long





This diagram illustrates the mechanism for locating the records after it has been completely assembled and put in place



"Wonderful, Charlie!"

"— and to think we never realized this gorgeous view was only an hour's ride from our door."

"It wasn't, Mae, 'till we got our Harley-Davidson! We never could have climbed up that path with a car.

"Isn't motorcycle touring great? Think of all the trips we took this past month, and our total expense for gasoline, oil and tires was less than eight dollars!

"One trip like this is worth that much, Charlie. I don't know what I'd do without our Harley-Davidson."

Ask your dealer for a demonstration of "The Best Sport in the World."

HARLEY-DAVIDSON MOTOR CO.
MILWAUKEE, WIS.

Largest Producers of Motorcycles in the World

Harley-Davidson

"World's Champion"

January, 1921

Tear Out The Wall

Between You and Success

Is there a barrier between you and the big job? Isn't that barrier the lack of "know how" which the big job requires? Wouldn't you like to acquire that "know how"? It is not difficult to do. You can quickly tear down the wall which separates you from Success. Eighty of the biggest men in the industrial world today stand ready to help you with methods and ideas that made them successful.

Put Yourself in the BIG SALARY Class Now

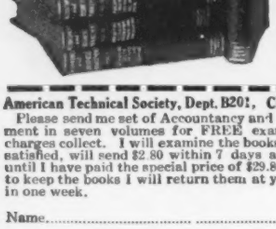
It's the fellow who "knows" that gets ahead—the man who knows "how" and "why" gets the worth-while jobs and the big salaries that go with them. It will take only a moment of your time to start toward a prosperous future. Fill out the coupon below—allow us to send you the seven big volumes making up the complete library on

Accountancy and Business Management

These great books contain a complete business training for the beginner and are a handy reference work for the executive. They cover every line of business—show all the new and better ways of doing things—explain methods by which men have made money and, best of all, show how YOU can make more money and rise to the position you would like to have. You don't have to send us a cent for the privilege of examining these books. Just fill out and mail coupon.

Prepares for
Business Executive
Accountant
Credit Manager
Bookkeeper
Cost Clerk

Over 25,000 sets have been sold. This is the 1920 edition—just off the press. Mail the coupon today.



American Technical Society
Dept. B201
Chicago
U. S. A.

American Technical Society, Dept. B201, Chicago, U. S. A.

Please send me set of Accountancy and Business Management in seven volumes for FREE examination, shipping charges collect. I will examine the books thoroughly and if satisfied, will send $2.80 within 7 days and $2 each month until I have paid the special price of $29.80. If I decide not to keep the books I will return them at your expense within one week.

Name.....

Address.....

City.....State.....

Reference.....

(Please fill out all lines)

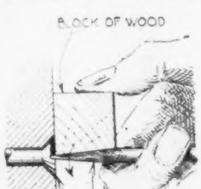
piece of drill-rod is pushed inward the short piece of drill-rod is pushed outward against the free end of the flat spring inside the form.

Pieces of cardboard 1/16 in. by 10¼ in. by 10⅛ in. are now placed in the grooves and the whole form placed in one of the shelves.

Insert the records between the pieces of cardboard. To take a record out, push the button (drill-rod with the battery terminal on the end) corresponding to that space and the record moves out about 1½ in. or more. Passe-partout and an index complete the record cabinet.

How to Extract a Broken Screw

IT is always a very difficult matter to remove a screw in which one side of the head is broken away. The business may be much simplified by following the plan indicated in the illustration. Here a small block of wood is cut. The screwdriver is then put into the groove and the block pressed well against the tool. As the screwdriver is turned, the block is moved around as well, with the result that the screw is easily loosened, even if it is rusty.—S. LEONARD BASTIN.

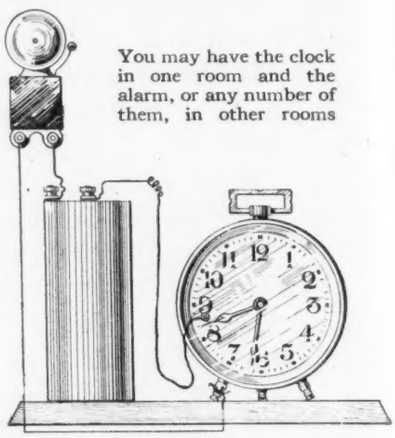


Turn the screwdriver with the block to remove screw

Supplying a Clock with an Electric Alarm

A SIMPLE and reliable electric alarm-clock may be made by taking advantage of the fact that the glass of a common round clock may be revolved but will stay set in any position.

A hole is drilled in the glass near the edge and a small machine screw is fastened in it by a nut on either side.



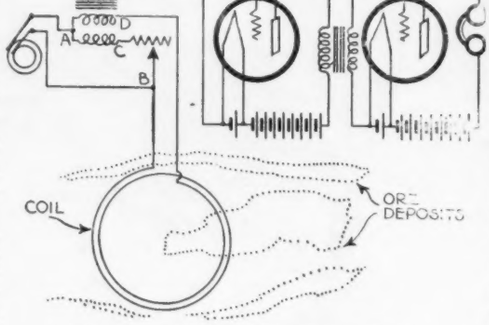
You may have the clock in one room and the alarm, or any number of them, in other rooms

A piece of fine spring brass wire, soldered to the hour-hand, projects slightly farther than the minute-hand and "wipes" this screw in passing. Care must be taken that the nut does not interfere with the motion of the minute-hand. A flexible wire, connected by means of a clip to this contact, forms the switch for setting or stopping the alarm.—G. H. ROUSE.

Prospecting for Ore with a Vacuum Tube

WILL the prospector of the future use a vacuum tube instead of the miner's pick or the geologist's hammer? W. L. Carlson and E. C. Hanson of Washington, D. C., seem to think so, for they have patented a means for locating ore bodies by audio-frequency currents. This way combines an audio-frequency generator, an exploring coil, a balanced circuit, and a vacuum-tube amplifier as shown in the sketch.

The generator supplies current to a divided circuit which looks like the familiar Wheatstone bridge. In one arm is a loop of wire; in another a resistance and inductance, which exactly balances with the loop. A telephone receiver is coupled to these two arms through a transformer and two stages of vacuum tubes. Provided there is balance no sound will be heard. But if the loop is brought into the vicinity of a body of ore the circuit will be thrown out of balance and a tone will be heard.



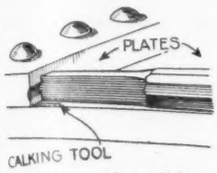
The arrangement of the loop of the ore-finder and the wiring of the exploring coils and induction balance is shown here

The prospector packs the generator, bridge circuit, and amplifies and uses the loop as an exploring coil. On moving the coil horizontally over the earth's surface, any change in the energy which the coil absorbs due to ore behind the surface will result in some unbalance current. The amplifiers make this audible.

The patent which was recently issued to the inventors gives no details as to the best size of coil or as to the depth at which ore may be detected. A somewhat similar method, however, has been used in France for locating unexploded shells which lie buried and are a constant source of danger to everybody in the localities where the armies fought.

Calking Boiler-Plates with an Improved Tool

ONE of the best forms for a calking-tool for boiler-plates is that shown in the accompanying illustration. The edge of the tool has a rounded, projecting rib, with a flat shoulder on each side. This compresses the metal and closes up the seam without making bad edges, and it does the work quickly and easily.

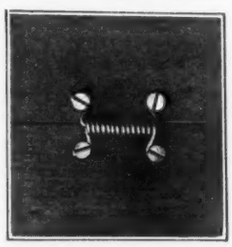


This shows the calking-tool as it is used

To get the best results, the rib on the edge of the tool should be applied a little below the center of the thickness of the plate. The illustration makes this point clear.

Why Not Make Your Own Hinges at Home?

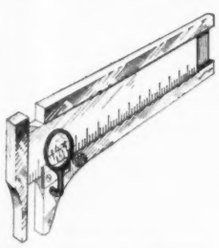
A SIMPLE hinge can easily be made from galvanized or copper wire. Take a wire which is not too thin. Cut off a piece about a foot long. Then take a heavy knitting-needle and, grasping the wire about an inch and a half from one end, begin to wind it carefully about the needle so as to get a perfectly uniform coil. Bend both ends backward and fashion a loop about ¾ in. from the coil. Into these loops the screws are later placed.


This homemade hinge may be very artistic

Now take a piece of the same kind of wire, pass it through the coil, and bend backward and form another pair of loops as shown in the illustration, and one hinge is complete.

A New Use for the Little Magnifying-Glass

READING a Vernier scale on any style of machinists' tool causes a considerable strain on the eyes, as the fine graduations are difficult to decipher. This is especially true of a gage such as shown here.


Greater accuracy is made possible by this lens

By bending a piece of ordinary wire, fastening it into the tool as shown, and mounting a magnifying-glass on top of the wire, the finest graduations will be seen with satisfactory clearness.—J. H. MOORE.

A RECORD

for the

Enders SAFETY Razor

13 years on the market
More than 2,000,000 in regular use.

Sold without a line of advertising—thru the personal recommendation alone of its enthusiastic friends.

The Reasons:

SIMPLICITY—only three parts. No adjusting. Apart in one second—together in three.

CLEANLINESS—no holes, no screws, no springs; instantly cleaned.

SAFETY—patented guard holds the blade firmly in place.

PRICE—One dollar.

Shaving with the Enders is ***"Just like wiping your face with a towel."***

Wm Enders

ENDERS SALES COMPANY, 17 Battery Place, New York

ENDERS SELLS FOR $1.00 with six blades of the best quality Swedish-base steel. Packed in a black Keratol box, velvet-lined. Extra blades, package of 5—35c.

FOR SALE BY BEST DEALERS EVERYWHERE.

An Ash-Tray Made from a

tubes. Provided there is balance no sound will be heard. But if the loop

everybody in the localities where the armies fought.

$95 an Hour!

"Every hour I spent on my I. C. S. Course has been worth $95 to me! My position, my $5,000 a year income, my home, my family's happiness—I owe it all to my spare time training with the International Correspondence Schools!"

Every mail brings letters from some of the two million I. C. S. students telling of promotions or increases in salary as the rewards of spare time study.

What are you doing with the hours after supper? Can you afford to let them slip by unimproved when you can easily make them mean so much? One hour a day spent with the I. C. S. will prepare you for the position you want in the work you like best.

Yes, it will! Two million have proved it. For 29 years men in offices, stores, shops, factories, mines, railroads—in every line of technical and commercial work—have been winning promotion and increased salaries through the I. C. S. More than 130,000 men and women are getting ready *right now* with the I. C. S. help for the bigger jobs ahead.

Your Chance is Here!

No matter were you live, the I. C. S. will come to you. No matter what your handicaps, or how small your means, we have a plan to meet your circumstances. No matter how limited your previous education, the simply written, wonderfully illustrated I. C. S. textbooks make it easy to learn. No matter what career you may choose, some one of the 280 I. C. S. Courses will surely suit your needs.

When everything has been made easy for you—when one hour a day spent with the I. C. S. in the quiet of your own home will bring you a bigger income, more comforts, more pleasures, all that success means—can you let another single priceless hour of spare time go to waste? Make your start right now! This is all we ask: Without cost, without obligating yourself in any way, put it up to us to prove how we can help you. Just mark and mail this coupon.

TEAR OUT HERE

INTERNATIONAL CORRESPONDENCE SCHOOLS
BOX 7609B, SCRANTON, PA.

Explain, without obligating me, how I can qualify for the position, or in the subject, *before* which I mark X.

ELECTRICAL ENGINEER	SALESMANSHIP
Electric Lighting and Rys.	ADVERTISING
Electric Wiring	Window Trimmer
Telegraph Engineer	Show Card Writer
Telephone Work	Sign Painter
MECHANICAL ENGINEER	Railroad Trainman
Mechanical Draftsman	ILLUSTRATING
Machine Shop Practice	Cartooning
Toolmaker	BUSINESS MANAGEMENT
Gas Engine Operating	Private Secretary
CIVIL ENGINEER	BOOKKEEPER
Surveying and Mapping	Stenographer and Typist
MINE FOREMAN or ENG'R	Cert. Pub. Accountant
STATIONARY ENGINEER	TRAFFIC MANAGER
Marine Engineer	Railway Accountant
Ship Draftsman	Commercial Law
ARCHITECT	GOOD ENGLISH
Contractor and Builder	Teacher
Architectural Draftsman	Common School Subjects
Concrete Builder	CIVIL SERVICE
Structural Engineer	Railway Mail Clerk
PLUMBING AND HEATING	AUTOMOBILE OPERATING
Sheet Metal Worker	Auto Repairing
Textile Overseer or Supt.	Navigation
CHEMIST	AGRICULTURE
Mathematics	Poultry Raising

Spanish
French
Italian

Name_____
Present Occupation_____
Street and No._____
City_____ State_____

Canadians may send this coupon to International Correspondence Schools, Montreal, Canada

7-26-19

An Automatic Coalbin

By Theron P. Foote

DOES your wife or your mother complain because she has had to go down-cellar and fill the coalhod? Perhaps it is not simply because she had to carry it up the stairs, but because she had to fill it as well. Build her an automatic coalbin, then show her that all she has to do is to take the coalhod down to the foot of the stairs, place it in the proper place and less than a minute afterward it is ready to be carried upstairs.

The construction is very simple and any schoolboy can make his mother happy.

Four 2 in. by 4 in., each about 9 ft. long, formed the corners of the structure. Odd pieces of board built the sides of the bin, the bottom boards necessarily being of heavy material so as to stand the weight. As a ton of coal occupies approximately 48 sq. ft. of space, and the coalbin illustrated holds approximately 100 sq. ft., it will readily be seen that the bin will hold over two tons or 4000 lbs.

Nothing strenuous about filling your coal-bucket provided the automatic bin is not empty

The bin should be situated about 3 ft. in front of a cellar window, so that the window may be opened or closed and thus conveniently located so that a chute from a coal-wagon can enter the bin by means of a few removable boards at the top and back.

If convenient, and much preferable, the tops of the four 2 in. by 4 in. should be spiked to the girders holding the floor above. This will steady the top of the bin and make it last much longer.

The chute from the bin to the hod may be made of heavy galvanized iron, and is in two pieces, one of which is securely fastened to the bin and is stationary; the other is fastened to the latter by means of hinges and is movable.

Pulleys tend to keep the bin closed and as one end of the cords are attached to the back end of the lever shelf the moment the hod is full, its weight will release and start to close the movable section of the chute.

The box weight underneath the bin and on one end of the lever shelf is filled with coal and acts as an additional supply which will give approximately another hod of coal after the bin is found to be empty and before the coalman has had time to refill it.

The lever is mounted between angle-irons and is slightly movable to the right and left from the front of the bin. This is done so that after setting the hod on the board on the lever shelf, and pulling down the chute, the handle may be securely fastened back of the lever. As the coal continues down and into the hod, the hod grows heavier, overbalancing the auxiliary coalbox, and letting the lever release handle and chute. As the cord attached to the chute is also attached to the coal-box, the upward movement of the coal-box causes the chute to start to close, the weights continuing the action and actually closing it.

The rods are strips of ¼-in. iron, the ends of which come in contact with a rod extending through and holding the sides of the stationary part of the chute thus preventing the movable part from dropping too low.

The front part of the lever shelf is built in the form of a tray so as to catch the few pieces of coal which are apt to jump the sides of the chute or overflow from the hod as it is being filled.

A ½-in. rod extends through two front legs of the bin and is the fulcrum for the lever shelf.

Why a Warm Hood-Cover Keeps the Engine Cooler

SINCE the practice of covering automobile bodies with pyroxylin-coated fabrics has become quite general, motorists often ask whether the covering of the hood with the heavy waterproof, airtight material does not cause the engine to heat up abnormally.

Probably there is a simple scientific explanation of why it doesn't work both ways. A hood-cover doesn't create heat; it merely retains the heat generated by the engine while in operation. In summer the engine generates no more heat than in winter, but the hot summer sun beating down on the enameled metal of the uncovered hood creates a much higher degree of heat than comes from the engine itself. The pyroxylin-coated fabric doesn't attract the heat to nearly as great an extent as the polished metal—in other words, it keeps out the heat generated by the sun, but keeps in the heat generated by the engine, such as does not escape through the vents.

glass on top of the wire, the finest graduations will be seen with satisfactory clearness.—J. H. MOORE.

An Ash-Tray Made from a Tin Box

MOST of us take pleasure in showing a friend some article we ourselves have made, and are delighted with their appreciation of our handiwork.

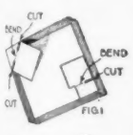
If you will but study the drawings and follow the description, you can

Does it not make you feel proud if your friend admires the ash-tray you made?

make an ash-tray that will be equal to anything bought.

Secure a tin box and use the lid for the cigar-holder.

Take a chisel and cut it, removing all of the unshaded part. Cut a slit as shown in the one corner so as to be able to bend the edges up after the fold is made.



This shows how to cut and bend the tin

After the unshaded part is cut away, bend the uncut parts back, as dotted lines indicate, pressing them down with the pliers, and then curve the edges up, as in Fig. 2, to hold the cigars. A piece of blotting-paper should be glued to the bottom of box to keep it from scratching the table.—CHESTER COOPER.

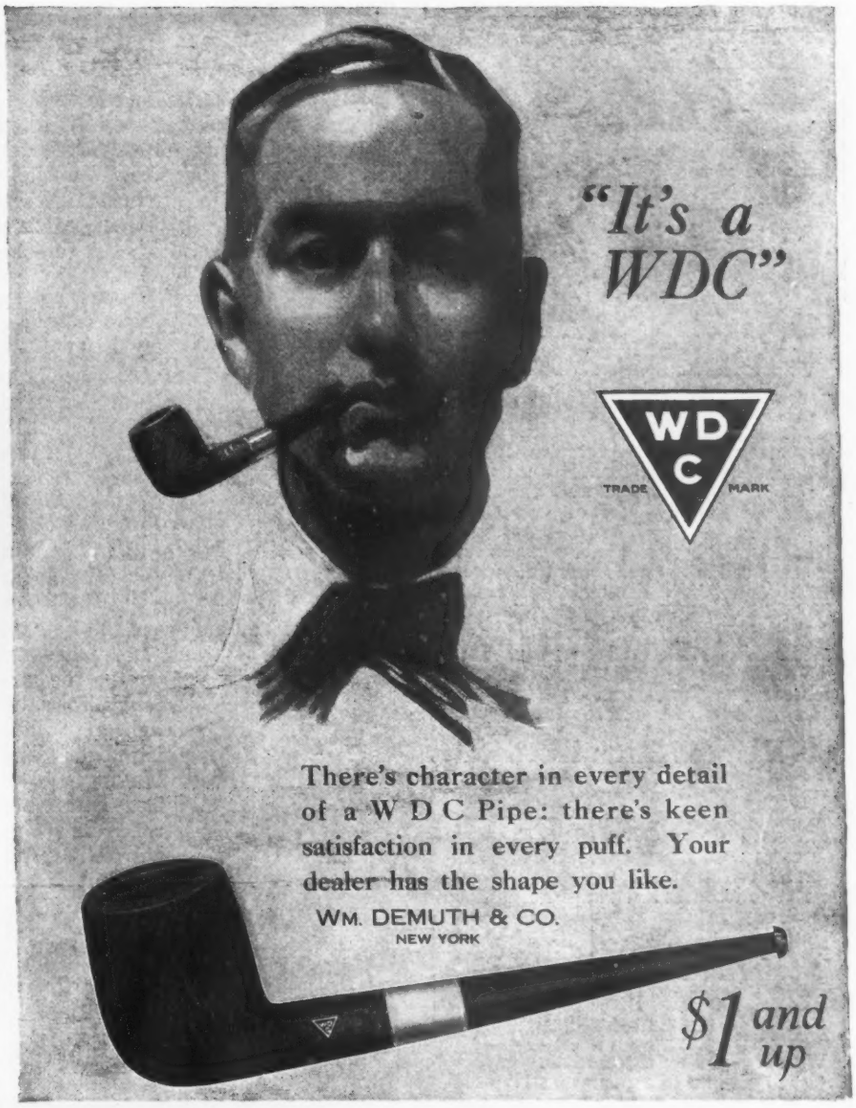
Repairing a Flexible Window in an Automobile

A CELLULOID window in my automobile hood having cracked, I mended it by the following simple method:

Take a strip of thin tough paper, coating it on both sides with a solution of Canada balsam dissolved in turpentine to render it transparent.

When dry, apply a little more solution to the edges on one side, stick over the damaged part and smooth out all wrinkles.

After twenty-four hours, coat both sides with good transparent varnish, and, if care has been taken in following directions, the repair will last for months.—GEORGE H. HOLDEN.


"It's a WDC"
WD C
TRADE MARK
There's character in every detail of a W D C Pipe: there's keen satisfaction in every puff. Your dealer has the shape you like.
WM. DEMUTH & CO.
NEW YORK
$1 and up

FREE BOOK
How To Study Music

Learn Piano!
This Interesting Free Book

shows how you can become a skilled player of piano or organ in your own home, **at one quarter usual cost.** Dr. Quinn's famous Written Method is endorsed by leading musicians and heads of State Conservatories. Successful 26 years. Play chords **at once** and complete piece in every key, **within 4 lessons.** Scientific yet easy to understand. Fully illustrated. For beginners or teachers, old or young. **All music free.** Diploma granted. **Write today** for 64-page free book, "How to Study Music".
M. L. QUINN CONSERVATORY, Studio ZA, 598 Columbia Road, Boston, 25 Mass.

DO YOU LIKE TO DRAW?
Cartoonists are well paid

We will not give you any grand prize if you answer this ad. Nor will we claim to make you rich in a week. But if you are anxious to develop your talent with a successful cartoonist, so you can make money, send a copy of this picture, with 6 cents in stamps for portfolio of cartoons and sample lesson plate, and let us explain.
The W. L. EVANS SCHOOL OF CARTOONING
825 Leader Bldg. Cleveland, Ohio

$1800 for a Story!

RECENTLY an American writer was paid $1800 for a single short story. By learning to tell the stories of her dreams this woman has found her way to fame and fortune. You can learn to write, too. A new practical course of instruction will give you the training right in your own home during your spare time. Endorsed by eminent writers including the late *Jack London*.
Write Today for new booklet "How To Write." No obligations—the booklet is free. Special offer now being made. Write Today—Now!
HOOSIER INSTITUTE, Short Story Dept. 1761, Ft. Wayne, Indiana

Learn the Sign-Show Card Business

Big field—unlimited possibilities—increasing demand for men with creative ideas. Our course develops ability and originality. Work intensely interesting.
EARN $25. TO $75. WEEKLY
You can do it if ambitious. Successful graduates everywhere. Our course covers every phase of work completely and thoroughly. Our graduates command big salaries. Write for catalog, samples, guarantee and Free Outfit Offer.
DETROIT SCHOOL OF LETTERING, 521 B. S. L. Bldg. Detroit, Mich.

LEARN AUTOS AND TRACTORS

Wonderful opportunities constantly offered trained men; we train you thoroughly to start your own business or make good money as motor expert, driver, shop foreman, etc.
5000 graduates making good. Catalog Free.
Cleveland Automobile School,
1821 E. 24th St., Cleveland, Ohio.

21 JEWEL BURLINGTON WATCH

The masterpiece of watch manufacture—adjusted to the second, positions, temperature and isochronism. Encased at factory into your choice of the exquisite new watch cases. The great Burlington watch sent on request. Pay at rate of $5.00 a month. You pay only rock-bottom price—yes, "bed rock-bottom price"—the lowest price at which the Burlington is sold.
Write Today See color illustrations of all newest designs in watches that you have to choose from. Name and address on a postcard is enough. Write today.
Burlington Watch Company
Dept. 19-1, 19th St. and Marshall Blvd., Chicago, Illinois
Canadian Office: 356 Portage Avenue, Winnipeg, Man.

$5.00 PER MONTH

Foreign Countries 3 for $5
No Agents

A Pocket PHONOGRAPH AT LAST!

The Phonilo is a simple pocket device that plays all needle records. Astonish your friends and win applause. It lasts a lifetime. Sells on sound. **Postpaid One Dollar in U. S.**
LOTS of FUN—NOT A TOY
Hand-Phonilo Co., A123 W. Madison Street, Chicago

Choose a Job

With Big Money

and a Big Future in It

Electrical engineering "fills the bill." There are no greater opportunities in any field than electricity offers. It is the most interesting of all professions. Science depends on electricity — from it comes the X-ray, the healing violet rays— electricity gives essential heat and light—ponderous electric locomotives pull heavy trains over mighty mountains—the telephone, the telegraph, the aeroplane, the automobile—all must use it. Electricity is life. Something new about it is discovered every day. The man who gets into this field right is sure to succeed. The demand for competent Electrical Engineers far exceeds the supply.

It is Easy to Master Electrical Engineering

Without giving up the work you are now doing, you can speedily prepare yourself to step into a man's size job with a real man's pay in the electrical field.

The Test

Just as gold must undergo the acid test, our instruction must undergo the test of service. This school stands out in front as the school that guarantees its instruction to satisfy, or the refund of every penny paid us.

You Hold the Key to Success in This Great Field

We offer you an extraordinary opportunity to get into this money-making profession. Let us tell you how we have helped thousands of other young men to secure big paying positions.

Let Us Send You Our Latest Electrical Engineering Book FREE

It tells you of all the wonderful things in which an Electrical Engineer is master. It shows exactly what his work consists of. It points the way to SUCCESS — to more money, and it is FREE to you. Send for it today. Mail the coupon now.

American School

Dept. E-201 Drexel Ave. & 58th St., Chicago.

AMERICAN SCHOOL

Dept. E-201, Chicago, Ill.

Explain how I can qualify for position checked:

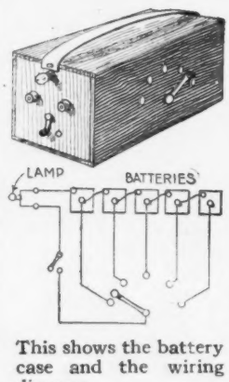
Architect $5,000 to $15,000	Lawyer $5,000 to $15,000
Building Contractor $5,000 to $10,000	Mechanical Engineer $4,000 to $10,000
Automobile Engineer $4,000 to $10,000	Shop Superintendent $3,000 to $7,000
Automobile Repairman $2,500 to $4,000	Employment Manager $4,000 to $10,000
Civil Engineer $5,000 to $15,000	Steam Engineer $2,000 to $4,000
Structural Engineer $4,000 to $10,000	Foreman's Course $2,000 to $4,000
Business Manager $5,000 to $15,000	Sanitary Engineer $2,000 to $5,000
Certified Public Accountant $7,000 to $15,000	Telephone Engineer $2,500 to $5,000
Accountant & Auditor $2,500 to $7,000	Telegraph Engineer $2,500 to $5,000
Draftsman & Designer $2,500 to $4,000	High School Graduate In two years
Electrical Engineer $4,000 to $10,000	Fire Insurance Expert $3,000 to $10,000
General Education In one year	

Name ..... Address .....

A Neat Arrangement of Dry Cells

WHERE a small electric light is used for illumination it is often desirable to use the dry cells during the day for other purposes, especially when the dry cells are used for the operation of different pieces of apparatus. It is a nuisance to disconnect the cells every time they are to be used, and the following will be found a happy solution of the problem.

A neat box with a hinged lid, large enough to hold the number of cells in use, is made. Three or five is a good number. On the side of the box a switch is placed having the same number of contacts as there are dry cells, in other words, a multipoint switch. On one end of the box near the top a socket to accommodate a miniature bulb of the desired voltage is placed. Below this two binding-posts are secured and near the bottom another single-point switch is placed to control the current to the light and binding-posts. The binding - posts and lamp are connected in parallel, and when it is desired to use the binding - posts, the bulb may be given a few turns to loosen it. This saves the use of another switch. If desired, the socket on the box may be dispensed with and the wires of the miniature lighting system connected directly to the binding-posts. A leather strap is fastened to the box, as shown, for a handle. One end of the strap has a hole cut in it, which slips over a hook at one end of the box, so as to allow the lid to be raised to get at the dry cells.



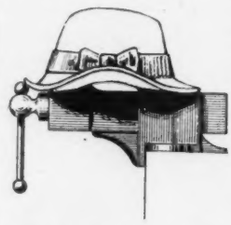
This shows the battery case and the wiring diagram

The dry cells are connected in series, that is, the positive pole of one cell to the negative pole of the other, and from each negative or outside pole a wire is lead to one of the contacts on the multipoint switch. Thus it will be seen that as many of the dry cells can be cut in or out of circuit as desired. The wires should be connected in the switch-points in consecutive order, so that as the blade of the switch is passed over the contacts, one after another of the cells is cut in or out of circuit.

The advantages in having the cells so arranged are many. Being in a box with a handle, they are easily carried about, and the ease with which the cells can be cut in or out of circuit is apparent. It will be found also that the cells will last longer and will be always ready when needed, and that no time is lost in connecting or disconnecting them when it is desired to use them.—GEORGE E. PERKINS.

Stretching a Felt Hat with a Vise

ANY one who has a felt hat that needs to be made a little larger can bring about the desired result without going to a hat-repair shop and spending money on the job. All that is necessary is an ordinary vise.



How a felt hat can be stretched with a vise

Make sure the vise is clean. Slip the hat over the jaws and open them out until there is sufficient pull to stretch the felt as much as is required. If there are sharp corners on the vise, put strips of thin, flexible wood, or springy metal, inside the hat to protect it. Care must be taken not to apply too much force, which would surely ruin the hat.—HOWARD GREENE.

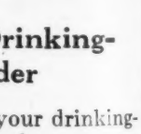
To Clean and Remove Paint from Iron and Steel

SIMPLE and effective is this way of removing paint from iron and steel. Dissolve 1 lb. of concentrated powdered lye in 3 qts. of hot water, adding lime to make the solution thick enough to spread evenly. The solution should be applied as soon as it is mixed by means of a brush and allowed to remain on the surfaces to be cleaned until it is almost dry. If it is then removed, it will take the paint with it, unless it is very old and thick, in which case a second coat of the solution should be applied after the first has been washed off the surface. Before applying a new coat of paint, the metal should be thoroughly washed with a solution composed of ½ lb. of sal soda dissolved in 2 gal. of warm water.

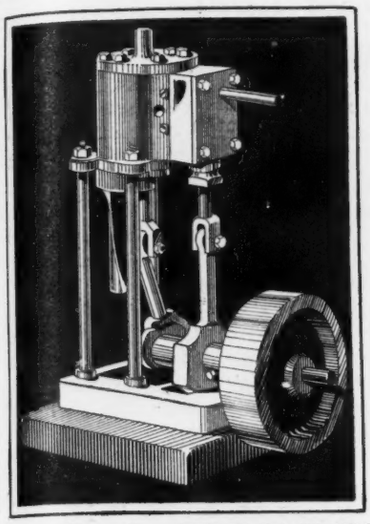
After the soda solution has been well applied, the surface of the metal should be wiped or warmed until thoroughly dried. A method similar to this is in use by the United States Coast Artillery for cleaning the exterior portions of big guns and their carriages.—F. A. MCLEAN.

A Homemade Drinking-Glass Holder

IF you wish to keep your drinking-glass from getting broken on your desk, keep it on a holder such as is shown in the accompanying illustration. To make the holder, drive a large wire nail or a piece of iron or brass rod, into a wood base. To the top of this solder two wires in the form of a cross, with the ends turned up. If iron wire is used, put a drop of solder on each tip to prevent rusting.



A block of wood, a nail, and some wire will make this holder



GET A HOBBY

MAKE MODELS

Start a Home Workshop

"*Model Making*," by R. F. Yates, describes the construction of model gas-engines, steam-engines, locomotives, boats, dynamos, turbines, railroads, guns, etc. Thirty chapters are devoted to models of various nature.

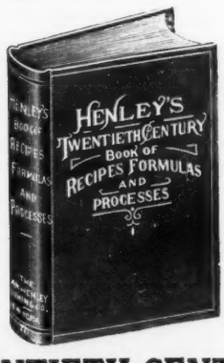
It will help you to become a better mechanic. It will help you to do hard soldering, soft soldering, lathe work, tempering, drilling, pattern-making, etc.

This is a book every amateur or professional mechanic and model maker should have.

"Model Making" describes real engineering models, not toys.

400 Pages, 300 Illustrations. Practical, complete, easily understood. Price, Postpaid, $3.00.

Popular Science Monthly
225 West 39th Street, New York



TWENTIETH CENTURY

Book of

Recipes, Formulas and Processes

This book of 800 pages is the most complete Book of Recipes ever published, giving thousands of recipes for the manufacture of valuable articles for every-day use. Hints, Helps, Practical Ideas and Secret Processes covering every branch of the useful arts are given.

10,000 Practical Formulas—The Best Way to Make Everything

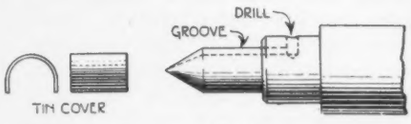
A book to which you may turn with confidence that you will find what you are looking for. A mine of information, up-to-date in every respect. Contains an immense number of formulas that every one ought to have that are not found in any other work.

Price $4.00

Popular Science Monthly
225 West 39th Street, New York

To Keep the Lathe-Center Well Oiled

A LATHE-CENTER on which work is revolving, should have some means of lubrication, so that the work being cut will not become overheated. Usually the machinist drops



With a cut made in this manner the lubricant feeds down to the lathe-center, thus keeping it cool

a little oil on it now and then, but this is poor practice.

By cutting a groove to the point of the center, as shown in the illustration, you provide an excellent method of lubrication. When the lathe-center is not in use, a tin shield can be placed over the hole.—J. W. MOORE.

Inexpensive Pipe-Cleaners Are Easily Improvised

AN ordinary clothespin can be put to another use, that of cleaning the inside of the bowl of your pipe.

As the pin is being rotated it works down and conforms to the shape of the bowl until the bottom is reached, thus removing the carbon from the wall of the pipe.

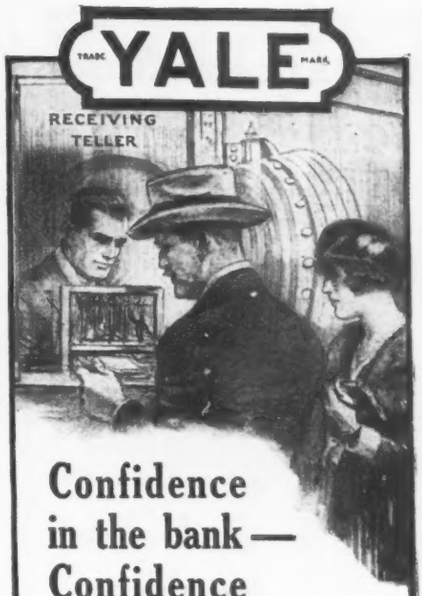
When your pipe needs cleaning, use a clothespin

If the bowl of the pipe is too large for the clothespin, insert a wedge in the cut of the clothespin. This will force the two prongs wider apart and thus make them fit the bowl.

Combining Two Useful Motor Accessories

LADIES motoring over dusty roads generally wear a veil to prevent the wind from taking undue liberties with their hair, and goggles to keep the dust out of their eyes. But those who have tried it know that a veil worn over goggles is not a comfortable arrangement.

Now an inventor, with the convenience and comfort of the feminine motorist at heart, places on the market a motor veil combining the two features in one article. A "shell" frame is fitted into the veil, holding in place a piece of pyroxylin sheeting cut to fit the frame. Thus there is no veil over the eyes; no glass to break; nothing to catch in the meshes of the veil and tear it. If a light amber sheeting is used for the "lenses," the eyes are also protected against sun glare.



Confidence in the bank—Confidence in the YALE Lock

Seventy-five per cent. of the bank locks in use in America are YALE.

Your banker selects the time-lock for his vault just as his depositors select their bank—by name and reputation. Only he is even more careful.

Bankers take no chances—they *know* the great security in YALE Timelocks, Combination and Safe Deposit Locks. They specify YALE in their contracts, insist upon getting YALE.

Bankers' associations have officially recommended the YALE Timelock Inspection Service.

Next time you go to *your* bank, ask to be shown the YALE Timelock, which for half a century has proven absolutely reliable.

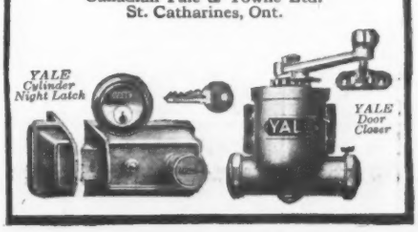
The same character present in every YALE Timelock is found in every other design of YALE Lock, in YALE Hardware, Padlocks, Night Latches, Door Closers, Chain Blocks, Industrial Electric Trucks.

Always buy by the name and be sure that it appears on the product.

YALE MADE IS YALE MARKED

The Yale & Towne Mfg. Co.
Makers of the Yale Locks

General Offices & Works: Stamford, Conn.
New York Office: 9 East 40th Street
Chicago Office: 77 East Lake Street
Canadian Yale & Towne Ltd.
St. Catharines, Ont.



Get A Canadian Farm
from the
CANADIAN PACIFIC

THE Canadian Pacific Railway offers you a great opportunity to own a farm home. Many of these farms have paid for themselves with the first crop. Out of its last big block of reserved farm lands you can buy your farm under a plan of long term easy payments that is remarkable in the history of farm investments.

Last Big Opportunity

Until this land is disposed of the Canadian Pacific Railway offers you the most wonderful opportunity in the world to own a farm, achieve independence and grow rich in Western Canada. It offers to sell you farm lands in the rich open prairies and fertile park lands of the Lloydminster and Battleford Districts of Central Alberta and Saskatchewan or in Manitoba for an average of about $18.00 an acre.

Twenty Years to Pay

The Canadian Pacific offers you this land under a plan of long term, easy payments. You pay down 10%. Then you have no payment on the principal until the end of the fourth year, then sixteen annual payments. Interest is 6%. In Central Saskatchewan, Seager Wheeler grew the world's prize wheat. World's prize oats were grown at Lloydminster.

Special Rates for Homeseekers and Full Information

The Canadian Pacific will not sell you a farm until you have inspected it. To make this easy, special railway rates have been arranged. Do not delay your investigation. This is the last great block of Canadian Pacific Reserved Farm Lands. Send today for complete information—without obligation.

M. E. THORNTON, Supt. of Colonization
CANADIAN PACIFIC RAILWAY
965 First Street E., Calgary, Alberta

Ask the Canadian Pacific about Canada — CANADIAN PACIFIC

BUREAU OF CANADIAN INFORMATION

The Canadian Pacific Railway will furnish you with the latest information on every phase of Canadian Life. No charge or obligation attached to this service. You are invited to make use of it. Write or call at the Bureau of Canadian Information at
165 E. Ontario St., Chicago
1270 Broadway, New York, or
335 Windsor Station, Montreal, P.Q.

Copy this Sketch

and let me see what you can do with it. Many newspaper artists earning $30.00 to $125.00 or more per week were trained by my course of personal individual lessons by mail. PICTURE CHARTS make original drawing easy to learn. Send sketch of Uncle Sam with 6c in stamps for sample Picture Chart, list of successful students, examples of their work and evidence of what YOU can accomplish. *Please state your age.*

The Landon School of Illustrating & Cartooning
2151 Schofield Bldg. Cleveland, O.

USE HB MOTORS PROMPT DELIVERY
Sturdy Ball Bearing Electric Motors
—Ample capacity, smooth-running and economical. Require little or no attention to operate. Under absolute money-back guarantee you run no risk. One to 10 h.p. Choose the size you need. Cash or easy payments. We plan your installation. Simply state machinery you wish to operate, current avilable, etc. Ask for information on HB battery chargers, lighting sets and generators. Write or wire today for information.
HOSART BROTHERS CO.,
Box S-15, Troy, Ohio

"STAMMERING
Its Cause and Cure"

You can be quickly cured. Send 10 cents for 288 page cloth bound book on Stammering and Stuttering. It tells how I cured myself after Stammering and Stuttering for 20 years. BENJAMIN N. BOGUE
674 Bogue Building Indianapolis, Indiana

Maximum Mileage from Minimum Gasoline

PROBABLY the largest waste of gasoline in this country is due to the habit of letting the engine run idle.

There are two other items that should receive consideration when attempting to secure fuel economy. They are the carburetor and ignition.

The automobile engine of today operates on a mixture which ranges from 8 parts of air and 1 of gasoline to 14 parts of air and 1 of gasoline.

The latter mixture, which is called a "lean" mixture, will give the better results. Despite this, many drivers use a mixture which is nearer the 8 parts of air and 1 of gasoline. This is known as a "rich" mixture and has a tendency to make the cylinders carbonize rapidly.

A rich mixture also makes the engine sluggish and prevents the quick getaway that is desirable when driving in city traffic.

The richness of the mixture depends on the adjustment of the carburetor, and the man who wants to be sure of the best results should have the job done at the service station.

Even when the carburetor question has been answered, the automobile owner does not want to rest his case, for a perfect carburetor alone will not answer the gasoline-wastage question. The ignition must be in perfect order. Cable connections at all points must be kept clean and tight.

Without a large, hot spark the mixture in the cylinders is not completely burned.

While these adjustments will go a long way in securing maximum mileage from minimum gasoline, there are many other details that should receive consideration.

The fuel tank and the pipe leading from it to the carburetor may leak, and such a leak is a tremendous waster of gasoline. This kind of a leak is difficult to locate. The man who keeps a check on his gas and his mileage is safe. Even if the owner keeps such a check, it is wise to go over the whole fuel system occasionally.

The filters and screens in the fuel system should be cleaned at stated intervals. One will be surprised to notice the increased power that results after the fuel pipe has been cleaned out. Every waste of power is a waste of gasoline.

The muffler on the modern automobile is designed to give little back pressure, so no cut-out is provided. The exhaust carries out a large amount of unburned carbon and unless the muffler is cleaned at times this unburned carbon will retard the exhaust gases and thus rob the engine of power.

Carbon in the cylinders is another cause of gasoline wasting. Scraping the cylinders will relieve this. If the valves do not seat properly, they will allow the fuel mixture to leak out.

If the clutch slips, there is not only an enormous waste of power, but the wear and tear on the engine.

Misalined wheels, as every motorist knows, wear tires rapidly. They also result in a loss of power. Another way to increase the gasoline bill is to have your brakes drag.

With the modern brake and its ease of adjustment there is no excuse for this.

The driver should let the automobile coast whenever possible, shutting off the ignition and pushing the gas-lever back as far as it will go. With the price of gasoline what it is to-day, use kerosene for washing metal parts and other work around the garage.

How to Waterproof Blueprints and Drawings

ARCHITECTS, engineers, contractors, linemen, etc., often have occasion to refer to drawings, blueprints, etc., in all kinds of weather, and usually find that before long their prints are in a very dilapidated condition.

A simple way of overcoming this trouble is to render them waterproof by saturating them with melted paraffin wax such as is used for sealing fruit-jars.

If the prints are placed directly into a pan filled with this molten wax, they will soak up too much of it and will always feel more or less greasy to the touch. The most convenient way, therefore, is to soak a number of pieces of absorbent cotton cloth a foot or more square, in the wax. When these pieces of cloth are cool, lay as many as are required (depending on the size of the blueprint) on a table or other smooth surface, place the print on top of these, and then on top of the print lay more of the cloths until it is entirely covered. After this is done, it is only necessary to run a hot iron over them for a few moments. The print will immediately absorb the paraffin until the surface becomes saturated.

If the table on which the work is carried out has a highly finished surface, a layer or two of heavy wrapping-paper should be placed between the cloths and the table.

Should one of the family irons be used in the process, it would be a good plan to interpose a piece of wrapping-paper between the iron and the cloth also, as it will prevent the iron from being fouled with the wax.—F. A. McLEAN.

"Don't tell me you never had a chance!

"Four years ago you and I worked at the same bench. We were *both* discontented. Remember the noon we saw the International Correspondence Schools' advertisement? That woke me up. I realized that to get ahead I needed special training, and I decided to let the I. C. S. help me. When I marked the coupon I asked you to sign with me. You said, 'Aw, forget it!'

"I made the most of my opportunity and have been climbing ever since. You had the same chance I had, but you turned it down. No, Jim, you can't expect more money until you've trained yourself to handle bigger work."

There are lots of "Jims" in the world—in stores, factories, offices, everywhere. Are *you* one of them? Wake up! Every time you see an I. C. S. coupon your chance is staring you in the face. Don't turn it down.

Right now over one hundred thousand men are preparing themselves for bigger jobs and better pay through I. C. S. courses.

You can join them and get in line for promotion. Mark and mail this coupon, and find out how.

INTERNATIONAL CORRESPONDENCE SCHOOLS
Box 7606B Scranton, Pa.

TEAR OUT HERE

INTERNATIONAL CORRESPONDENCE SCHOOLS
BOX 7606B, SCRANTON, PA.

Explain, without obligating me, how I can qualify for the position, or in the subject, *before* which I mark X.

- ☐ ELECTRICAL ENGINEER
- ☐ Electric Lighting and Railways
- ☐ Electric Wiring
- ☐ Telegraph Engineer
- ☐ Telephone Work
- ☐ MECHANICAL ENGINEER
- ☐ Mechanical Draftsman
- ☐ Machine Shop Practice
- ☐ Toolmaker
- ☐ Gas Engine Operating
- ☐ CIVIL ENGINEER
- ☐ Surveying and Mapping
- ☐ MINE FOREMAN OR ENGINEER
- ☐ STATIONARY ENGINEER
- ☐ Marine Engineer
- ☐ Ship Draftsman
- ☐ ARCHITECT
- ☐ Contractor and Builder
- ☐ Architectural Draftsman
- ☐ Concrete Builder
- ☐ Structural Engineer
- ☐ PLUMBING AND HEATING
- ☐ Sheet Metal Worker
- ☐ Textile Overseer or Supt.
- ☐ CHEMIST
- ☐ Mathematics
- ☐ SALESMANSHIP
- ☐ ADVERTISING
- ☐ Window Trimmer
- ☐ Show Card Writer
- ☐ Sign Painter
- ☐ Railroad Trainman
- ☐ ILLUSTRATING
- ☐ Cartooning
- ☐ BUSINESS MANAGEMENT
- ☐ Private Secretary
- ☐ BOOKKEEPER
- ☐ Stenographer and Typist
- ☐ Cert. Public Accountant
- ☐ TRAFFIC MANAGER
- ☐ Railway Accountant
- ☐ Commercial Law
- ☐ GOOD ENGLISH
- ☐ Teacher
- ☐ Common School Subjects
- ☐ CIVIL SERVICE
- ☐ Railway Mail Clerk
- ☐ AUTOMOBILE OPERATING
- ☐ Auto Repairing
- ☐ Navigation
- ☐ AGRICULTURE
- ☐ Poultry Raising
- ☐ Spanish
- ☐ French
- ☐ Italian

Name_____
Present Occupation_____
Street and No._____
City_____ State_____

Canadians may send this coupon to International Correspondence Schools, Montreal, Canada

7-25-19

Build Your Own PHONOGRAPH

IT'S EASY WITH OUR HELP

Get our FREE Blue Print Offer

DEALERS WANTED FOR OUR Ready Built Phonographs

A few hours' interesting work saves many dollars—gives you a fine machine exactly suited to your ideals—better than many machines costing much more. Plays any record.

We furnish complete, simple plans and diagrams—anyone can understand them—motors, tone arms, case material, everything required, and full instructions. F. C. Strong, Canada says: "Please send me one of your circulars, 'How to Build Your Own Phonograph,' as I would like to make one. Mr. Gallie has built one and if he hadn't told me that he had made it himself I would have taken it for a $150 model." Listen to this from Charles F. Mancke, Wash.: "Received the two outfits, and am well pleased. I built one machine for myself and took an order for one for $175. I now have mine done, and it has a wonderful tone. I would not take $200 for it."

We are the originators of the home building idea. Our customers always succeed because our plans and system are easy and clear. No special skill necessary.

SAVE OVER HALF

Make Big Money Building Phonographs

Ask for Our Sure-Fire Plan and Free Blue Print Offer

You can make hundreds of dollars easily. Ask us. We tell you how and help you. We have started many others. We can start you. Pleasant, easy work. N. J. Adams, Michigan, says: "Just sold my phonograph which I built from your plans and parts at nearly $100 profit. Only took about a week working evenings to build it. Those who have heard it say that it is better than phonographs they have seen and heard at $200."

Become a Home Dealer—Wonderful Plan

Our dealers' proposition on our ready built Phonograph will appeal to you. It's the best thing yet. No canvassing—no work—no capital needed. It works every time. We give you full particulars and show you how to make sure, easy money. Remember, we are the old reliable house-originators of the home building and home dealers idea. Write today. Get our proposition. Have a fine phonograph at half price and make money besides.

Choraleon Phonograph Co., 121 Second Street ELKHART, IND.

DONT SLAVE at a DESK Day After Day!

Be a **Railway Traffic Inspector**—Pleasant, healthful work—Position guaranteed.

Be out-of-doors—Travel or remain near home. Get into this wonderful new profession with many opportunities for promotion. Earn $110.00 Monthly to Start and advance quickly up to

$250 per Month and More

All expenses paid. Steady, fascinating work. Any ambitious, average man over 18 years of age can qualify.

Three Months' spare-time, home study prepares you. No books to buy; no expense except modest fee, which is returned to you if position is not secured.

Don't delay. Investigate today. Remember, **we guarantee you a position.** Send for FREE booklet D-222, giving all details.

STANDARD BUSINESS TRAINING INSTITUTE

BUFFALO, N. Y.

Learn Music At Home!

Easy Lessons Free!

Piano, Organ, Violin, Saxophone, Flute, Clarinet, Ukulele, Trombone, Cornet, Guitar, Banjo, Mandolin, Harp, 'Cello, Sight Singing. No longer need the ability to play be shut out of your life. Just write us a postal today for our new Free Book, fresh from the printer. Let us tell you how you can easily, quickly, thoroughly learn to play your favorite musical instrument by note in your own home, without a teacher, by our New Improved Home Study Method, *without paying a cent for lessons!* Different, easier than private teacher way—no tiresome, dry exercises—no inconvenience. No trick music, no "numbers," yet simple, wonderful, amazingly easy for even a mere child.

250,000 Pupils!

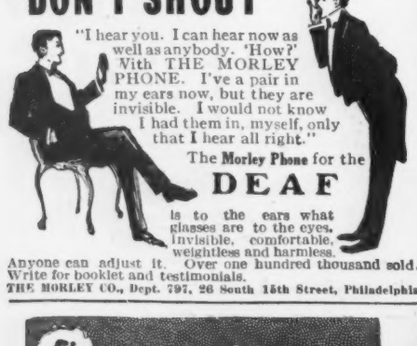
We have successfully taught over 250,000 people, from seven to seventy, *in all parts of the world!* Hundreds write—"Have learned more in one term in my home with your weekly lessons than in three terms with private teachers." "Everything is so thorough and complete." "The lessons are marvels of simplicity. My 11-year old boy has not had the least trouble to learn."

Wonderful New Book Free!

We want to have *one pupil in each locality at once* to help advertise our wonderful easy system of teaching music. *For a limited time*, we therefore offer our marvelous lessons *free*. Only charge is for postage and sheet music which averages just a few cents weekly. Beginners or advanced pupils. We have hundreds of pupils *right here in New York*, the musical centre of America, who prefer our Home Study method in place of best private teacher. Get all the proof, facts, letters from pupils, *amazing free offer* and fascinating New Book just issued, *all free!* Write postal today. Address

U. S. School of Music, 81 Brunswick Building, New York

"DON'T SHOUT"



"I hear you. I can hear now as well as anybody. 'How?' With THE MORLEY PHONE. I've a pair in my ears now, but they are invisible. I would not know I had them in, myself, only that I hear all right."

The **Morley Phone** for the

DEAF

is to the ears what glasses are to the eyes. Invisible, comfortable, weightless and harmless. Anyone can adjust it. Over one hundred thousand sold. Write for booklet and testimonials.

THE MORLEY CO., Dept. 797, 26 South 15th Street, Philadelphia.

BECOME A LAWYER

Study At Home. Legally trained men win high positions and big success in business and public life. Greater opportunities now than ever. Be a leader. Lawyers earn **$3,000 to $10,000 Annually**

We guide you step by step. You can train at home during spare time. We prepare you for bar examination in any state. Money refunded according to our Guarantee Bond if dissatisfied. Degree of LL. B. conferred. Thousands of successful students enrolled. Low cost, easy terms. Fourteen-volume Law Library free if you enroll now. Get our valuable 126-page "Law Guide" and "Evidence" books free. Send for them—NOW.

LaSALLE EXTENSION UNIVERSITY

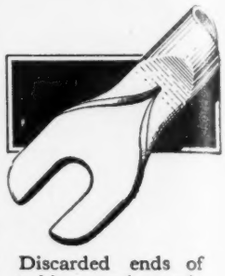
Dept. 183-L Chicago, Ill.

The Prophy-lac-tic Tooth Brush

Most of your friends use it and *profit* by it

How to Fashion a Wrench from Steel Tubing

ODDS and ends of steel pipe or cold-drawn tubing are good material for wrenches, the making of which does not present great difficulties. Take a piece of steel pipe or tubing and split it at one end for a distance of a few inches. Hammer the split portion out flat as shown in the picture, and then cut out a slot which will fit the particular kind of nut for which you wish to use the wrench.



Discarded ends of tubing can be made into useful wrenches

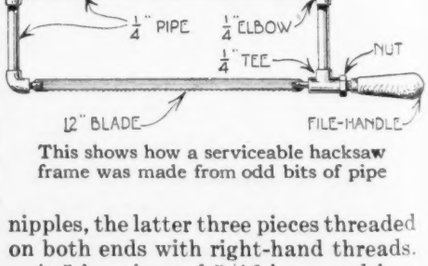
You can easily make for your shop or garage a number of such wrenches fitting a variety of nuts. The cost is insignificant and the making of the wrenches requires little time, labor, and skill.—J. H. MOORE.

Making a Hacksaw Frame at Home

IT happened on Monday, July fifth, a holiday in celebration of July Fourth, which fell on Sunday. The previous Saturday we purchased six new hacksaw blades to be fully prepared for cutting all the conduits necessary, as we intended to spend our holiday installing the conduits for the wiring of our house.

Then, accidentally, we broke our hacksaw frame. We tried to borrow one from our neighbors, but no one seemed to have one, so we decided to make one.

Out of some spare ¼-in. gaspipe fittings we took three 90° ells, one tee, a 1/15-in. length of pipe, and two 3-in.



This shows how a serviceable hacksaw frame was made from odd bits of pipe

nipples, the latter three pieces threaded on both ends with right-hand threads.

A 5-in. piece of 5/16-in. round iron rod was pipe-threaded on both ends, one end to a depth of ½ in. and the other end for about 2½ in. This rod we cut into two pieces, one piece 1 in. long having the ½ in. of thread, the other 4 in. long and having the 2½ in. of thread. The unthreaded ends were slotted to a depth of ½ in. and holes drilled with a No. 20 drill, perpendicular to the slot. The 1-in. piece was threaded into the ell, the blade inserted in the slot, and a cotter-pin through the hole and blade, to hold it in place. The threads of the tee on the

opposite end were filed out and the 4-in. end was inserted in the tee, the blade fitting in the slot, and another cotter-pin was used to hold that end in place.

A 5 16-in. nut was then screwed on the other end and a large wooden file handle, drilled out, was threaded on the 4-in. piece.—T. P. FOOTE.

How to Straighten Metal that Is Warped

THROUGH uneven heating and cooling, metal is often warped. Case-hardened pieces cannot be straightened either by pressure or pounding, as this treatment results in cracking the case.

The usual treatment of a piece of case-hardened metal is to find the

A simple method of straightening metal parts that have become warped in case-hardening

"high" or "bowed" part, then mark this area with chalk. Heat slightly; never a red heat. The amount of heating, depending on how strongly the metal is warped, is determined by trial.

Clamp in a vise between blocks as in sketch. Direct a stream of cold water over the warped area. This will contract the expanded side and the steel will become straight.

A "Finder" for Workmen Out of the Shop

AMONG various devices that have been used for the purpose of avoiding loss of time in finding workmen who may have gone out on another job, the one here illustrated has several advantages. It is conspicuous; it is so easy to operate that there is no excuse for neglecting to keep it properly set, and it has the feature of being adaptable for the use of two or more different persons, without being confusing in its indications.

On a dial that may be hung on the door of the shop, are marked the names or numbers of various places to which the workmen are likely to be called, and an arrow for each of the

Electrical Books Sent to You For One Week FREE

Here are the world's greatest Electrical Books. You can have them for a weeks' Free use in your home or shop. Eight big books, 4000 pages of money-making facts. More than 3000 pictures, blue prints and diagrams that make everything clear as day. Prepared by 28 of the world's master electrical minds in plain every day English that any one can understand. They teach you electricity from the ground up. They explain everything—from the simple wiring of electric bells to the mighty electric machinery you see in the power houses. They save you the money it would cost to go to an electrical school. They save you years of hard work as an apprentice. Old-time electricians say "they are the finest books they ever saw." See our free trial—easy payment offer below.

Master These Subjects

Principles of Electricity; Telephones; Construction, Operation and Repair Dynamos and Motors; Storage Batteries; Alternating Current Machinery; Switch Boards; Armature Winding; Construction and Operation of Transformers; Electrical Measurements; Electromagnets; Induction Coils; Controllers; Electric Elevators; Railway Signaling; Interior and Exterior Wiring; Materials and Methods Used; Underwriters' Requirements; Electric Lighting; Planning Systems; Estimating; Contracts; Specifications; Maintenance; Electrochemistry; Power Stations; Operation and Maintenance; Management of Dynamos and Motors; Electric Welding; Electric Transmission Lines; Distributing Systems; Electric Railways; Construction of Power Plants; New Electrical Devices.

Get in the Big Money Class

Electricians Earn $60 to $100 a Week

The electrical field is seriously under-manned. Thousands of men who *know what's what* are needed right now to fill important jobs such as Sub-Station Operators, Switch-board Operators, Dynamo and Motor Tenders, Installation Experts, Trouble Men and Engineers. The work is fascinating and the pay is big.

Your Future Is in Electricity

Electricity is the greatest force in the world and it is growing greater every day. The whole world depends on the electrician. Think what opportunities this offers to the fellow with a little ambition. You can succeed in electricity. You can have a big job and the big pay that goes with it. These books will show you the way.

Don't Send Money

Prove to yourself how easy it is to master electricity by getting these books for a weeks' free use. Just mail the coupon and the whole set will come to you at once. If you don't like them—if you don't think they will do for you what we claim—send them back at our expense and you won't owe us a cent. If you are satisfied with the books in every way just send us $2.80 as first payment and $3.00 each month, until $34.80 is paid. This is only a dime a day. Most of us waste more than this. Mail the coupon now and get a membership in this Society, **Free.**

Mail Coupon For These 8 Big Books

AMERICAN TECHNICAL SOCIETY
Dept. E-201, Chicago

Please send me a set of Practical Applied Electricity in 8 volumes by express collect, for a week's free use. At the end of a week I will either send the books back at your expense or send you $2.80 as first paymont and $3.00 each month thereafter until a total of $34.80 is paid. I understand that I will get a consulting membership in your Society, FREE with the books.

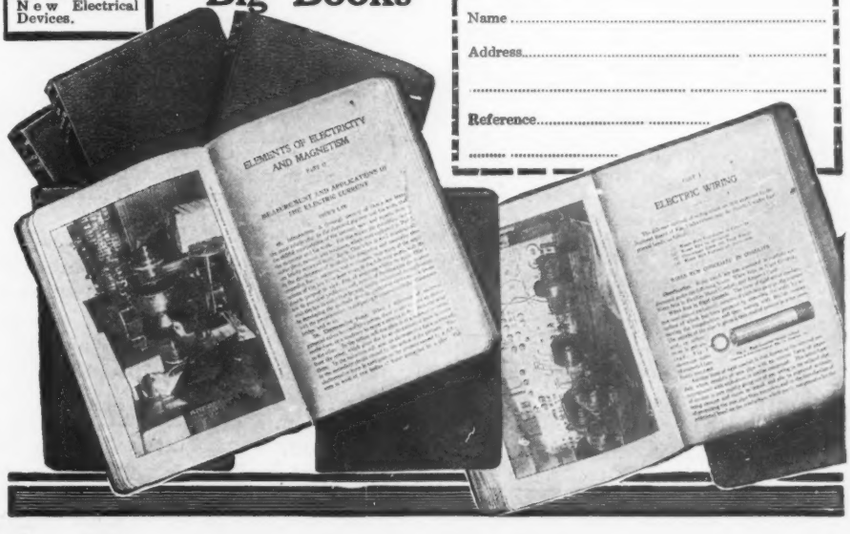
Name .....

Address .....

.....

Reference .....

.....



Better than a mustard plaster

Once when grandma's joints commenced to ache and twinge, she used to go to the mustard pot and make a mustard plaster. Now she goes to Musterole and gets relief, but does without the blister and the plaster, too!

My, how good that Musterole feels when you rub it in gently over that lame back and those sore muscles. First you feel the gentle tingle, then the delightful, soothing coolness that reaches in the twinging joints or stiff, sore muscles.

It penetrates to the heart of the congestion. This is because it is made of oil of Mustard and other home simples. And the heat generated by Musterole will not blister.

On the contrary the peculiarity of Musterole lies in the fact that shortly it gives you such a cool, relieved feeling all about the twingey part.

And Musterole usually brings the relief while you are rubbing it on. Always keep a jar handy.

Many doctors and nurses recommend Musterole.

35c. and 65c. jars—$3.00 hospital size.

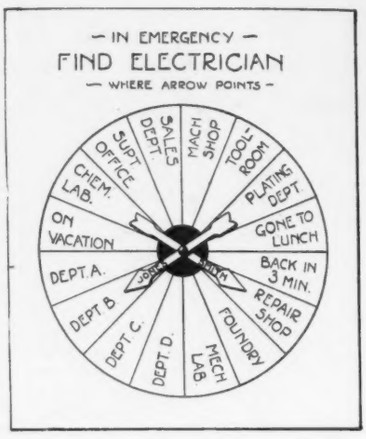
The Musterole Co., Cleveland, Ohio

BETTER THAN A MUSTARD PLASTER

MUSTEROLE

WILL NOT BLISTER

men is balanced on a pivot-bolt at the center. The bolt should be set up fairly tight, and a thick washer should be under each arrow, to give clearance. When set as in the sketch, the dial indicates that Mr. Jones is to be found in the superintendent's office, while



Each man is represented on the dial by an arrow that indicates where he is

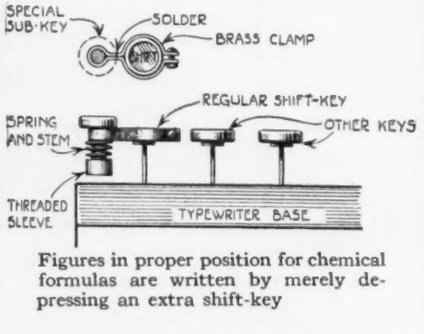
Mr. Smith is at work in the mechanical laboratory.

If made in "idle time," such a device costs almost nothing, and may save enormous loss at times of accident or other emergency.—CURTIS RALSTON.

Typewriter Attachment for "Sub" Figures

THE accompanying illustration shows the simple construction of a device which was fitted to a chemist's typewriter, and which saved him much time and trouble.

In chemical writing, and also in various other classes of work, it is necessary frequently to write figures slightly below the line, as in H_2SO_4. On nearly all typewriters it is possible to install some such key as the one



Figures in proper position for chemical formulas are written by merely depressing an extra shift-key

here illustrated, which elevates the carriage just the proper distance to write these figures.

The construction, which would have to be modified slightly in proportion and position of parts to fit it to other makes of machines, is quickly seen in the sketch. A special key is fitted to the top of a stem that works up and down in a little sheet-brass clamp, which is tightly attached to the regular shift-key. The lower end of the stem is threaded, and a short

MADE FOR U.S. GOVERNMENT

$12 FULL LENGTH HIP BOOTS

$5.50 WE PAY POSTAGE

GUARANTEED FIRST QUALITY

These $12.00 U. S. Army Hip Rubber Boots were left by cancellation of government orders. Every boot is new and bears official stamp of the U. S. Gov't Inspector. Send now before it is too late. Why not save money by ordering 2 or 3 pairs? NOW ONLY $5.50 a pair. Pay on arrival. You risk nothing. If you are not perfectly satisfied, we will return your money at once.

ALL SIZES 7 TO 12

SEND NO MONEY

Knee Rubber Boots $4.75 Rubber Boot Socks, 45c

Show this wonderful Offer to your friends.

Write, or mail coupon, as you prefer.

EAST BOSTON MAIL ORDER HOUSE
61 Armory Bldg., East Boston, Mass.

Send U. S. Gov't. Hip Rubber Boots, C. O. D. My money back if not satisfied.

Size Name.....

..... Address.....

SIMPLE WIRELESS TELEPHONES AND HOW TO MAKE THEM. An elemental book on the principles, construction and use of an arc system of wireless telephony. Illustrated. Price, postpaid, 25 cents

POPULAR SCIENCE MONTHLY
225 West 39th Street New York

President Suspenders for comfort

A useful holiday gift

MADE AT SHIRLEY MASSACHUSETTS

BLUE PRINT READING

CARPENTERS, Shipfitters, Bricklayers, Structural, Concrete and Sheet Metal Workers, Electricians, Mechanics, Plumbers, Pipefitters, Boilermakers and others can earn more money if they know how to read Blue Prints. By our simple method, we train you in a short time. Write for Catalog B, stating trade.

BE A DRAFTSMAN
Earn $35-$150 Week

Draftsmen are in demand. Books and tools FREE. Write for Catalog G. DO IT TODAY!

Columbia Correspondence School Est. 1904
Carroll Dept. Drexel Bldg., Phila, Pa.

Standard Makes
$5.00 Down
Lowest Typewriter prices
Guaranteed, fully inspected, strongly rebuilt, $5.00 down, 6 months to pay balance. Send us your address and we will mail you at once details of the Most Startling Offer
5 DAYS TRIAL in typewriter values. Don't miss this genuine opportunity to secure your machine at a price you'll gladly pay.
INTERNATIONAL TYPEWRITER EXCHANGE
Dept. P.S. 177 N. State St., Chicago

FREE $20

TENOR BANJO Ukulele, Hawaiian Guitar, Violin, Mandolin, Guitar, Cornet or Banjo

Wonderful new system of teaching note music by mail. To first pupils in each locality, we give a $20 superb Violin, Mandolin, Ukulele, Guitar, Hawaiin Guitar, Cornet, Tenor Banjo or Banjo absolutely free. Very small charge for lessons only. We guarantee success or no charge. Complete outfit free. Write now. No obligation.

SLINGERLAND SCHOOL OF MUSIC, Inc. Dept. 603 CHICAGO, ILL.

Cleartone Phonographs
$4.00 to $200.00 Retail

Our Sundry Dept. offers Needles 39c per thousand. Motors $1.35 to $14.75 each. Tone-Arms and Reproducers $1.50 to $5.75 per set. Main Springs 20c to 90c each Records, Needles, Sapphire Points and Parts at reasonable prices.

Write for our 84-page catalogue, the only one of its kind in America, illustrating 33 different styles of Talking Machines and over 500 different Phonographic Parts.

LUCKY 13 PHONOGRAPH COMPANY
Export Dept. 503G. East 19th Street, New York

Elements of Industrial Chemistry

By ALLEN ROGERS. Contents: General Processes; Water, Its Uses and Purification; Fuels; Sulphuric Acid: Nitric Acid; Elements and Inorganic Compounds; Ceramic Materials and Products; Pigments; Fertilizers; Illuminating Gas; Coal Tar and Its Distillation Products; The Petroleum Industry; The Destructive Distillation of Wood; Oils, Fats and Waxes; Lubricating Oils; Soap, Soap Powder and Glycerine; Essential Oils; Resins, Oleo-Resins, Gum-Resins and Gums; Varnish; Sugar; Starch, Glucose, Dextrin and Gluten; Beer, Wine and Liquor; Textiles; Dyestuffs and Their Applications; The Paper Industry; Explosives; Leather. About 600 pages, illustrations. Price, $3.00, Postpaid.

BOOK DEPT. POPULAR SCIENCE MONTHLY
225 West 39th Street, New York City

called, and an arrow for each of the

sleeve is tapped to fit the stem thread. This sleeve is, for purposes of quietness, best made of fiber or hard rubber, though brass tubing will serve the purpose. Between the sleeve and the clamp, around the stem, is a coil-spring of the open or compression type.

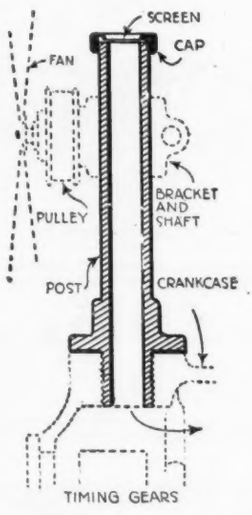
The action of the device will be clear at once: The shift-key can be operated as usual, owing to the compressibility of the coil-spring. When the "sub" key is pressed, the shift-key is thereby depressed only slightly, the amount of such depression being regulated by turning the sleeve on the sub key stem.

This throws the index numerals out of alinement and brings them more than halfway below the line, in the position which they take in chemical formulas.

Using the Fan Support as a Breather-Pipe

WE recently encountered an engine that failed to develop the proper amount of power, and an examination revealed that the breather-pipe a far too small in size, for when it was removed from the crankcase, a distinct rise in power was noticed.

We were about to provide for another breather on the opposite side of the case, when a thoughtful workman,



By drilling a hole through the steel post supporting the fan, it became a breather-pipe and oil-vent

who was overhauling the fan assembly of this same engine, noticed that the supporting post was made of a solid bar of rolled steel.

It occurred to him that a hole bored clear through this post, and provided with a screen and nut at the top, would give additional air connection to the inside of the crankcase, and, further, that it would afford an excellent filling-cap for pouring oil into the front compartment of the case that housed the timing gears. The illustration shows the manner in which the idea was carried out. It proved eminently successful and worthy of adoption in any similar case, provided the conditions make it feasible.—ADOLPH KLEIN.

Learn Automobile Tractor and Flying Business

HENRY J. RAHE
Founder and President

I HAVE invested 14 years of my life and over 2 million dollars in building up my school, until now it is the greatest and most proficient Automotive Training School in existence.

COME to the Rahe School—the world's oldest and greatest Automotive School—and get into a steady, big-paying business. **Make yourself sure of a steady, big income.**

The 9 million Automobiles, Trucks and Tractors now in use have got to be kept up and running. Thousands more of Rahe Trained men are needed for that right now in every section of the country. Prepare yourself here in 6 to 8 weeks, and take your pick out of thousands of high-pay positions now waiting for you. Or open your own business in one of the 50,000 places now calling for new shops and sales agencies.

Rahe School

$2,000 Net Profit.
About three years ago I took up the training at the Rahe School and have been running a garage ever since. I do all kinds of automobile work. My business nets me over $2,000 a year.—Emerson Shutt, Mediapolis, Iowa.

Making $8 a Day.
I am making $8.00 a day here, and I give the Rahe School credit for my ability to hold this job. —Vernon D. Larabee, Lansing, Mich. (1408 N. Larch.)

Age 20—Earns $5,000
I am 20 years old and have had training at the Rahe School. I own and operate my own garage. I do all kinds of work and my business is paying me around $5,000 a year.—Ernest Christensen, Waynesville, Mo.

Makes $75 a Week.
I am owner and manager of a repair shop here. I took training at the Rahe School a year ago. I do all kinds of repair work on automobiles and my business pays me around $75 a week.—D.D. Cates, Burlington, N. C. (Route 3)

Income $40 a Week.
My wages were very small before taking up Rahe Training, but now I have my own shop and a steady income of about $40 a week.—C. C. Cady, Parker, Kansas.

2 Million Dollars Invested
AUTO—TRACTOR—AIRPLANE
14th Year—38,000 Graduates

As a Rahe Trained man, you always have the advantage over all other men not trained here. Over 38,000 men already Rahe Trained are better trained men. They know the best and quickest way to learn is through my school. I always have more calls for men than I have students.

The thousands of Rahe Trained men now in business for themselves in every State are always sending to me for more Rahe Trained men than I can furnish. By coming here, you get preferred opportunity for a good job, or for a business of your own immediately upon leaving the school.

Four (4) big buildings (equal to 20-story skyscraper); big tractor farm and big flying field. Complete and thorough training in every branch of the business. Plenty of opportunity to earn part living expenses while in school.

Low-Priced Life Scholarship Now.

Free Catalog Before you arrange to go to any school, visit this School. If you can't come now, do the next best thing—send for my 84-page free catalog. The coupon below will do. Catalog shows fully by photographs how you learn best here—how you are sure of the best opportunities after you receive your Rahe Training.

HENRY J. RAHE
Dept. 2889 Kansas City, Mo.

MAIL THIS TODAY!

Mail This Coupon for special tuition offer and big 84-page illustrated catalog giving proof of graduates' success and showing the many opportunities now open. All sent FREE.

Name.....

Address.....

Age..... *Occupation*.....

Are You A Reject?

Like a damaged product of the factory?

Look in the glass. See if what you see there is a full fledged man, or a piece of damaged goods—a reject of society—nerves gone, vitality sapped, energy lacking, ambition lost—a weakened, trembling, hopeless, joyless mortal who feels that life is not worth living, and the world looks dark and gloomy.

The guilty man shudders at the spectacle he sees in the mirror. You know when you are face to face with yourself what has made you what you are, if you are of the guilty ones.

Don't be a Half-Baked Misfit

You can brace up and be a real man—a wholesome looking, handsome, healthy chap—a man any employer would be glad to have around—a man every man and woman will instinctively take to right off. You can do it—if you will listen to a little common sense as it is taught by a man who made himself the best physical specimen in the world, then devoted himself to the rehabilitation of other men and women and so succeeded that thousands now acclaim him the wonder-worker of the age.

STRONGFORT
The Perfect Man

Strongfortism Will Put You On Your Feet

Strongfortism works miracles in men, yet it is so easily adopted that, without interfering with any ordinary occupation, you can have health and vitality and vigor restored. If you are a sufferer from Nervous Disorders, Bad Habits, Excesses, Weaknesses, Catarrh, Indigestion, Rheumatism—or any other dread affliction, I urge you to learn what I can do for you. So wide-reaching is my system that I can remedy almost any physical fault by purely natural means *without the use of drugs or medicines.* It's great—you'll admit it as soon as you know anything about it. My Free Book tells all about it.

Send For My Free Book

Do not delay—you need it

I know I can confer upon you tremendous benefits—I know you'll thank me as other thousands have—that's why I want to give you an insight into my wonderful method by sending you my highly interesting and valuable book.

"Promotion and Conservation of Health, Strength and Mental Energy."

Don't lose a minute. Send a 10c piece for postage, etc., to my address. Tell me your ailment. I will reply promptly—you'll devour the truths found in my book and you will see at once that a new era of life is within your grasp.

LIONEL STRONGFORT
Physical and Health Specialist
DEPT. 160 NEWARK, N. J.

FREE CONSULTATION COUPON
Absolutely Confidential

Mr. Lionel Strongfort — Dept. 160, Newark, N. J.; Personal—Please send me your book "PROMOTION AND CONSERVATION OF HEALTH, STRENGTH AND MENTAL ENERGY," for postage on which I enclose a 10c. piece.

Send me special information on subjects marked X below without in any way obligating me.

.. Colds	.. Constipation	.. Skin Disorders
.. Catarrh	.. Biliousness	.. Great Strength
.. Hay Fever	.. Torpid Liver	.. Falling Hair
.. Asthma	.. Indigestion	.. Weak Eyes
.. Obesity	.. Nervousness	.. Pimples
.. Headache	.. Poor Memory	.. Blackheads
.. Thinness	.. Rheumatism	.. Round Shoulder
.. Rupture	.. Gastritis	.. Lung Troubles
.. Lumbago	.. Heart Weakness	.. Female Disorders
.. Neuralgia	.. Poor Circulation	.. Weak Back
.. Flat Chest	.. Increased Height	.. Muscular Development
.. Deformity (describe)	.. Successful Marriage	.. Advanced Course
.. Insomnia	.. Easy Childbirth	.. Healthy Children
.. Short Wind	.. Despondency	.. Manhood Restored
.. Flat Feet		
.. Stomach Disorders		

Here mention other subjects not listed above.....

Name .....

Age..... Occupation.....

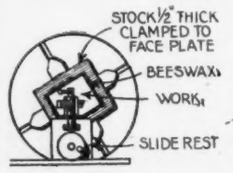
Street .....

City..... State.....

Holding Thin Pieces for Lathe Machining

MUCH difficulty is usually experienced in holding thin pieces to be machined in the lathe, shaper, miller, etc.

By using beeswax a firm, even contact results. Pieces as thin as 1/16 in. can be held firmly enough for a fairly heavy cut to be made. Heavier pieces can be held without the aid of clamps which would interfere with the machine-work.

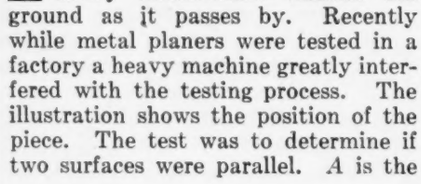


Beeswax applied to the table of the machine cuts thin metal easily

The beeswax is melted and applied thinly to either the faceplate of the lathe or table of the shaper or miller. But the best method is to have a piece of parallel stock about ½ in. thick to which the wax is applied and which in turn is clamped to the faceplate or table of the machine. After the wax cools, the piece to be machined is heated slightly and pressed firmly on the wax-covered surface, being held under pressure for a minute or two until the wax hardens.—S. B. ROYAL.

How Vibrations Interfere with Exact Measuring

EVERY one knows that a train or heavy motor-truck shakes the ground as it passes by. Recently while metal planers were tested in a factory a heavy machine greatly interfered with the testing process. The illustration shows the position of the piece. The test was to determine if two surfaces were parallel. *A* is the piece being tested. *B* is a dial indicator, an instrument used by machinists to test surfaces. It has a movable point that is brought to touch the surface, and by means of enclosed gearing a needle registers the movement of the contact point in thousandths of an inch. *C* is a parallel made of 2-in. square steel 65 in. long. *D* is a strap which, by means of the bolt shown, holds the parallel *C* on the surface, *F*, which is being tested with the surface *E*.



This test showed that vibrations caused by heavy machinery interfere with delicate tests

The reading on the dial is first taken, and the indicator *B* is moved to the other end of the parallel *C* and

Hang Pictures on Needle Points.

By a simple twist of the wrist, place Pictures, Charts or Drawings, on any surface with

Moore Push-Pins

Glass Heads—Steel Points

Harmonize with any color scheme; can be used over and over. For heavy Pictures, Mirrors, Hanging Bookshelves, etc., use

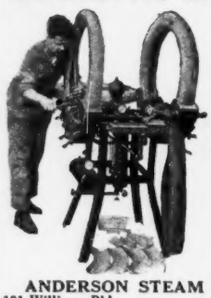
MOORE PUSH-LESS HANGERS, Brass finish.

"The hanger with the twist." Samples Free.

Sold everywhere by Hardware, Stationery, Drug, Photo Supply and Department Stores. 15c per pkt.

MOORE PUSH-PIN CO.,
11-1 Berkley Street, Philadelphia, Pa.

BIG PROFITS IN VULCANIZING



Make $10 to $30 per day with Anderson Steam Vulcanizers. Better tire repairing at one-tenth the usual cost. Big profits. We teach you the famous Anderson method of Vulcanizing, also the operation of the Anderson Super-heated Vulcanizer and Anderson Retreader and how to build up a successful business in your town with little capital. There are Anderson schools of vulcanizing in 34 states. It's the schooling plus equipment that makes Anderson tireologists distinctive. The course requires 5 to to 10 days and costs $35.00. If you buy an Anderson Vulcanizer at any time we refund your $35 and pay you $5 per day expense money for each day of the 10 days served because we sell the work you do.

ANDERSON STEAM VULCANIZER CO.
101 Williams Bldg. Indianapolis, Ind., U. S. A.

CLASS PINS

FREE CATALOG GIVE NAME OF SCHOOL OR CLUB AND NUMBER IN CLASS

Either pin illustrated made with any equal amount of lettering, one or two colors enamel. Silver plate, 25c ea., $2.50 doz. Sterling silver, 50c ea., $5.00 doz. Write to-day for new catalog.

BASTIAN BROS. CO.
288 Bastian Bldg., Rochester, N.Y.

AGENTS—Auto Free

We need special agents to travel by Automobile introducing our great line of Nationally-advertised Pure Food Products, Soaps and Household Necessities. Here is an opportunity to earn $6 to $12 a day, all of spare time and obtain an Automobile FREE besides. Write at once for full particulars. Address

AMERICAN PRODUCTS CO.
2823 American Bldg., Cincinnati, O.

WHY DONT YOU WRITE THE WORDS FOR A SONG

WE'LL HELP YOU ALONG

By composing the music FREE and publishing same. Send poems today.

D. E. LENOX CO., 271 W. 125th St., N.Y.

FREE TRIAL

Cut out this ad and mail it to us, with your name and address (no money); and we will send you our FAMOUS KARNAK RAZOR by return mail, postpaid. You may use the razor for 30 days FREE; then if you like it, pay us $1.85. If you don't like it return it. SEND NO MONEY.

MORE COMPANY, Dept. 397 St. Louis, Mo.

World's Best Poultry Books

Free Catalogue on Request!

Positively latest and most reliable profit-earning books on Houses, Fixtures, Feeding, Culling, Use of "Lights", Incubating, Brooding, Prolific Egg Yield, Back-Yard Poultry Keeping, etc., etc. Do not grope in dark! "Know your business." Post card or letter brings FREE catalogue. 32 pages.

Reliable Poultry Journal Pub. Co., Dept. 131 Quincy, Ill.

Dollars in Hares

We pay $7.00 to $18.50 and up a pair and express charges. Big Profits. We furnish guaranteed high grade stock and buy all you raise. Use backyard, barn, cellar, attic. Contract and Illustrated Catalog Free.

STANDARD FOOD AND FUR ASS'N
407C Broadway New York

read to see if it is the same as at the other end.

It was found that this overhanging bar *C* made the dial register a vibration of 3-1000 in. every time a heavy machine, running 20 ft. away, reversed. A truck going by the factory caused a registration of 2-1000 in., while a locomotive and freight-cars registered 5-1000-in. vibration on the dial.—RALPH A. WRIGHT.

Photographing Books with the Movie Camera

THE modern public library has adopted the camera and the photostat as mutual aids to the research worker and patent attorney. One asks for a book, picks out a chapter or illustration, and has photographic copies made of as many pages as desired, for a nominal fee. The service in most cases is accurate and quick—but it will soon have to be even faster to hold its own, if the public takes to

Copying pictures and print with a moving-picture camera saves time

using the small moving-picture camera in copying out-of-print books, etc.

It is possible to use these photographs whether reduced or enlarged. The latest edition of a noted encyclopedia was photographically reproduced page by page and a facsimile edition printed and sold by thousands. So many important patents are "out of print" when sent for, that the official delay of "twelve weeks" is a very serious matter, and manual copying is expensive.

What is to be done? Why not use a moving-picture camera? It is easy to arrange such a camera so that, with a crank motion such as we see in many adding-machines, one single film unit will pass the lens every time the crank is turned.

Here is the way the camera is worked: The light of a "semi-lamp" or a mercury arc is focussed on the book, document, or manuscript and the pages are turned by hand or by special large clips, so that the hand will not show in the picture.

After some practice, this operation can be done at the rate of about one exposure a second. If we depend upon the one exposure a second, we shall be safe, as at that rate we get sixty

LEARN WIRELESS At Home By Mail

Calls Coming in Steadily for National Radio Institute Graduates. Big Concerns in Need of Operators

Many attractive positions are now open in Merchant Marine, Commercial Land Radio Service, Radio Supply Factories, U. S. Navy, Aerial Mail, and large Business Corporations

SALARIES UP TO $3,500 A YEAR

Exceptional opportunity for ambitious men for promotion to the higher branches of Radio. Our graduates are qualified as Senior Operators, and besides Room and Board, receive $125 a month to start, which altogether means more than $200. Positions to which they can promote themselves are as follows: Supercargo and Wireless Operator—$175 a month; Radio Mechanic—$1,500 to $2,000 a year; Radio Aid—$6.00 to $8.00 per day; Radio Inspector—$1,500 to $3,000 a year; Radio Engineer—$6,000 and more a year; Radio Draftsman—$7.00 to $10.00 a day. You can learn wireless the National Radio Institute way, quickly and easily, by mail right in your own home, in your spare time. No previous experience or training is necessary. With our help you can quickly qualify for first grade government license and a fine position.

U. S. DEPARTMENT OF COMMERCE RECOGNIZES N. R. I.

and allows its graduates 5 to 10 points credit when taking the examination for First Grade Government License. This school heads the printed list of reputable Wireless Schools recommended by the U. S. Shipping Board.

TRAVEL WITHOUT EXPENSE

If you are eager to travel, anxious to visit foreign countries, and increase your knowledge of world affairs, Wireless offers the chance of a life time. On shipboard you are rated as an officer. You need not travel unless you wish, but may secure a position at one of the many ever increasing land radio offices.

NEW AUTOMATIC WIRELESS INSTRUMENT FREE

In addition to all necessary text books and other equipment with which we supply you, we furnish FREE to every student our marvelous new automatic Natrometer, which transmits Wireless messages in 600 different combinations and can be regulated to operate at any speed from 1 to 30 words a minute.

It is complete with phones, etc., and is sent you in a neat carrying case. This instrument is operated entirely without the use of aerials and is used exclusively by the National Radio Institute to teach Wireless at home in the scientific way.

You receive the instrument after your enrollment; it becomes your personal property upon completion of our course.

SEND FOR FREE BOOK

Write to-day for FREE BOOK "Wireless the Opportunity of To-Day," containing interesting and valuable information.

NATIONAL RADIO INSTITUTE
Dept. 426 **Washington, D. C.**

LAW STUDY AT HOME BECOME AN LL.B.

This is the only law school in the U. S. which conducted a **standard resident school** and gives its students identically the **same instruction by mail.** We are legally qualified and authorized to confer the **Degree of Bachelor of Laws—LL. B.—by correspondence.** Over 450 lectures delivered in classrooms and especially revised for our students by a large corps of prominent, practicing lawyers. Our **Law Library** consists of 24 volumes bound into 12 books of **Students' Standard Text Books,** prepared at an enormous cost exclusively for the use of our students by one of the largest and most reliable law book publishers in America. Written guarantee to prepare graduates to **pass** bar examination. $60.00 course in Oratory and Public Speaking **given free.** Thousands of successful graduates. Only school of its kind in America. Established in 1910. Write today for Illustrated Catalog which will give you the **Facts**—the **Proof**—the **Evidence.**

Hamilton College of Law, 507 Morton Bldg., Chicago

Learn How to WRESTLE

In Your Own Home By Mail

Yes, learn to become an expert wrestler right in your own home, **by mail,** from the greatest wrestlers the world has ever known. Be an athlete, be strong, be healthy. Learn how to throw and handle big men with ease. Learn to defend yourself. Learn from the **World's Champions,**

Farmer Burns and Frank Gotch

Farmer Burns, who taught **Frank Gotch**—trainer of SEVEN **World's Champions,** will teach you **Scientific Wrestling—Physical Culture—Jiu-Jitsu and Self-Defense.** Your name, age and address on a post-card or letter, brings you our **Fine Illustrated athletic and wrestling Book absolutely FREE**—no obligations of any kind. Grasp this wonderful opportunity. State age.

Farmer Burns, 1781 Ry. Exch. Bldg., **Omaha, Neb.**

Wrestling Book Free

Free Trial

YOU may have any instrument with complete musical outfit, for a week's free trial at home. No obligation. Return it at our expense after trial if you wish.

Outfit includes velvet lined case, self instructor, music and all accessories at factory cost. A tremendous saving.

Convenient Monthly Payments

A few cents a day will pay for instrument and outfit. Wurlitzer instruments are known all over the world for artistic quality.

Send Coupon for Beautiful New Catalog

Every instrument known illustrated with price, easy terms and free trial blank. Catalog absolutely free. Write today.

The Rudolph Wurlitzer Co., Dept. 1781
147 E. 4th St., Cincinnati, O.—329 S. Wabash Ave., Chicago

Send me your new catalog illustrated in color with full details of Wurlitzer Complete Outfits and free trial and easy payment offer.

Name .....

Address .....

.....

(State instrument you are especially interested in.)

Trade Mark Registered.
WURLITZER
200 YEARS OF MUSICAL INSTRUMENT MAKING

Copyright 1920 *Rudolph Wurlitzer Co.*

Could you hold your own?

You probably haven't had a real fight since you were very small. Settling a dispute with your fists is the last thing you'd think of. And yet, a time may come when you will *have to fight.*

Suppose you saw a rowdy in the act of insulting a woman. Could you look the other way? No, sir, you'd want to step right up and teach him the lesson he deserved. But *could* you? A quarrel might lead to the challenge "Come outside and fight." Could you do it and hold your own? Or suppose you were attacked in a deserted street after dark. You'd *have to fight!* Your very life might depend upon being able to disarm the thug and cripple him with a powerful blow or jiu jitsu hold.

Remember, those two fists of yours are the best weapons if you know how to use them—they're always with you, always ready.

Marshall Stillman will teach you boxing and self-defense in your own home. His system is the result of 30 years' study—he's an expert boxer himself, and a pupil of Professor Mike Donovan who retired undefeated middleweight champion of the world.

In his course, the fundamentals (hitting, guarding, ducking, feinting, and footwork) are easily learned, because you start by practising simple movements before a mirror—the breast stroke in swimming, holding out your hand for a coin, etc. Subconsciously you are led into striking heavy blows, guarding, ducking, feinting, etc., just as though you had a real opponent before you.

When you've mastered the fundamentals, you're taught every good blow in the ring—when to land it, where to land it, and how to guard against your opponent's counter attack.

Then comes *shadow boxing.* Marshall Stillman has combined such scientific blows as the Jack Dempsey Triple, the Bennie Leonard Triple, the Mike Donovan Double, etc., into three lively rounds for daily practice.

You're also taught 12 wrestling holds and 15 jiu jitsu holds—how to disarm a man with a pistol, dagger or club, how to break a strangle hold, etc.

The course includes a set of muscle building exercises, The Colon Exercise (a remedy for constipation) and Synthetic Breathing (a lung developer and aid in curing nervousness).

As an added feature there's an illustrated history of 69 great boxers with "inside" stories seldom heard outside professional circles. There are 246 illustrations in the course.

Sent Free on Approval

The entire course is sent on approval. You keep it 10 days, and then if not satisfied, return it. If you buy it, you have till the 15th of the following month to pay ($5 in the U.S., $6 in Canada, $7 in foreign countries). Mail the coupon to

Marshall Stillman Association, Suite F-201, 461 Fourth Ave., New York

COUPON

Marshall Stillman Association
Suite F-201, 461 Fourth Ave., New York

You may send me your complete course in Boxing and Self Defense, including extra instruction described above. I give you my pledge that you may feel safe in trusting me as agreed, and that I will pay $5 ($6 in Canada; $7 in foreign countries) for the course on the 15th of next month or return it in 10 days after I receive it.

Name .....

Address .....

AN EASY WAY TO MAKE MONEY

Don't be content to plod along on a small salary. Be independent. Go in the tire repairing business. One man says "I made $60.00 the first day." Others average $200 to $500 a month. Very little capital needed. Jobs plentiful. Every motorist a possible customer. No experience needed. We teach you.

SHALER Tire Repair Outfit

Improved Wrapped Tread Method Used by Tire Manufacturers

Does as good work as the big high priced vulcanizing outfits. A boy can use it. It's the only vulcanizer that has Automatic Heat Control, and can't undercure or overcure a tire. Requires no watching or regulating.

FREE Book

"How to Open a Tire Repair Shop." It tells how to make big money. Don't delay. Write quick.

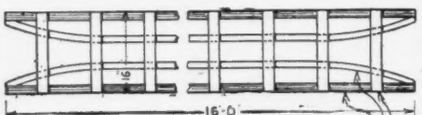
C. A. SHALER CO.
2100 Fourth St. Waupun, Wisconsin

copies a minute. When we allow for fatigue of the operator, we may take an average of one third of this or twelve hundred pages an hour.

One great advantage is that no special apparatus is necessary to obtain clear pictures of book pages. A good sky illumination is sufficient in most cases.—"VAN BRUNT."

A Strong yet Light Ladder from Furring Strips

STRONG yet light ladders may be made from furring strips, such as are used in building construction for stay-laths or braces. The writer has



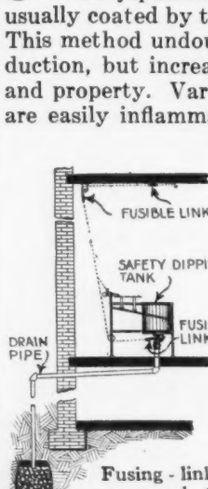
This ladder may be easily made from a few furring strips and a handful of nails

made many such ladders and found them very satisfactory.

The accompanying illustration clearly illustrates the construction of the ladder. The two bent strips, which are nailed to the uprights and to each rung of the ladder, materially add to the strength and rigidity of the ladder.—W. F. QUACKENBUSH.

For Safety First in the Japanning Shop

SMALL articles of metal which are to be japanned or enameled are usually coated by the dipping method. This method undoubtedly speeds production, but increases the risk to life and property. Varnishes and enamels are easily inflammable and their use, especially in large quantities, as required in dipping, makes necessary special precautions against fire and explosion.



Fusing - links are used to diminish the risk of fire and explosion

The accompanying illustration shows the method adopted in a large metal factory to diminish the danger of ignition in the dipping department. Mechanical arrangements are provided of such a nature that the heating of the dipping-room to a predetermined temperature—say, 150° F.—will automatically cause the covering of the dipping-tank and the discharge of its contents through a pipe to the outside of the building.

When the heat in the room, through some cause, reaches the critical point,

YOU Can Do YOUR Own SOLDERING and All Metal Repairing With

USED BY U. S. AND ALLIED GOVERNMENTS IN WAR

A PASTE THAT TURNS INTO METAL WHEN HEATED

A match will do it. Requires no acid or soldering iron. Joins or repairs wires, metals or metalware. Sold by hardware and electrical stores or sent by us postpaid.

SOLDERALL CO., Dept. A,
129 SUSSEX AVE., NEWARK, N. J.

COMBINATION SET Tube and Torch Complete **$1.50**

Dealers Send for Quantity Prices

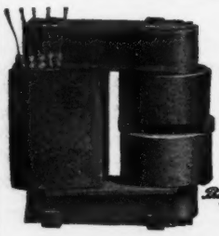
Look for Trade Mark "SOLDERALL." Beware of imitations with similar names

LEARN PARLIAMENTARY Procedure and Public Speaking

Be the Leader. We teach you by mail the rules of Parliamentary Procedure and the duties of the presiding officer in conducting lodge, union or club meetings—all that governs the deliberative or legislative assembly. The Course, prepared by Herman Ames Philips, for 15 years Journal Clerk, National House of Representatives, and John Philpot Curran, LL.B., is based on the rules used in Congress. Low cost, easy terms. Write for free illustrated booklet of pointers for speakers.

AMERICAN PHILOMATHIC SOCIETY
Dept. 121 127 No. Dearborn St. Chicago, Ill.

Wireless Telegraph Transformers



With which any amateur can cover great distances. Write today for Bulletin on Wireless.

The Packard Electric Company
Warren, Ohio

GET BIG BUSH OFFER

We do not deal through distributors but County Agents only. GET OUR BIG MONEY CATALOG TODAY. Don't wait! Learn how you, in your spare time can make Big Money, introducing Bush Cars in your County. The cars with Money-Back guarantee. Bush light four and De Luxe six. Don't wait. Write today!

Big Money-Making Offer for County Agents Only

BUSH MOTOR CO., Chicago, Illinois, Dept. AIH, Bush Temple

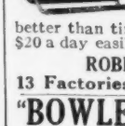
Build This Phonograph Yourself

TREMENDOUS SAVING IN COST

Easy, fascinating work, with our SIMPLIFIED PLANS. We furnish blue prints, diagrams, motor, cabinet pieces, ready-built horn, etc. You don't need to be a cabinet-maker. A few hours assembling and you will have a fine instrument at *one-quarter the regular retail price.* AGENTS MAKE MONEY making and selling these instruments. Write today for full details and our FREE OFFER. Address—

MODERN PHONOGRAPH SUPPLY CO.
412 Springer Building
313 So. Clinton St. CHICAGO, ILL.

Agents $85 Weekly



Get a Robinson Folding Bath Tub FREE. Big seller. Costs little, no plumbing. Weight 15 pounds, folds into small roll. Full length baths, far better than tin tubs. Guaranteed 10 years. $15 to $20 a day easily made. Write quick for special offer.

ROBINSON CABINET MFG. CO.
13 Factories Bldg. Toledo, O.

"BOWLEGS and KNOCK-KNEES" UNSIGHTLY

SEND FOR BOOKLET SHOWING PHOTOS OF MEN WITH AND WITHOUT

The Perfect Leg Forms

PERFECT SALES CO., 140 W. Mayfield Ave., Dept. 45, Chicago, Ill.

safe, as at that rate we get sixty

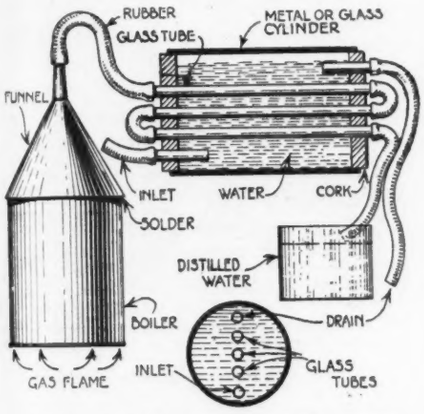
Copyright 1920 Rudolph Wurlitzer Co. (State instrument you are specially interested in.)

fusible links, placed at several points, are melted, thereby releasing counterweights the dropping of which causes the covers of the dipping-tanks to descend and the discharge valve under the tank to open. The liquid in the tanks is then rapidly discharged through the drainpipe to the ground outside of the building.

Make Your Own Still for Battery Water

WITH the greatly increasing use of storage batteries in automobiles the demand for pure or distilled water has increased. It is unnecessary to purchase this water or pay the garage man to put it in the battery. With this simple and inexpensive still any one can distill water for refilling the batteries as the occasion requires.

As shown in the illustration accompanying this article, the boiler or tank in which the water is turned to steam, is made of a quart or half-gallon can or bucket with rolled seams. Be sure they are not soldered at the bottom. The top of the can or bucket is open. Procure a large tin funnel that will fit



Why pay for distilled water for your storage battery? Make your own still

over the top of the can and then solder firmly and tightly in place as shown. This completes the boiler.

The condenser consists of three lengths of glass tubing each 12 in. in length. These tubes pass through a larger tube or a piece of iron pipe or brass tube of sufficient size to accommodate the tubes with some space between them. Fit a large cork into each end of the large pipe or tube and pass the three glass tubes through the corks. Then into each cork fit a short length of glass tube, one at the bottom, the other near the top of the large tube. Connect the free ends of the long tubes with rubber tubing so that they will form one long continuous tube.

Fill the boiler half full of clean water by submerging, and place it over a gas flame until the water comes to a boil. Connect the top of the funnel with one free end of the glass tube through the condenser by a short length of rubber tube. Slip a short length of rubber tube over the

What Happens

When you brush teeth in this way

Five quick effects occur when teeth are brushed in this scientific way.

Millions now get them twice a day. Leading dentists everywhere urge all to get them.

Ask us for this 10-Day Tube. It will show what these effects mean in whiter, cleaner teeth.

The five effects

Pepsodent multiplies the salivary flow. That is nature's tooth-protecting agent.

It multiplies the starch digestant in the saliva. That to quickly digest the starch deposits which, if left, form acid.

It multiplies the alkalinity of the saliva. That to neutralize the acids which cause tooth decay.

Two factors directly attack the film on teeth. One keeps the teeth so highly polished that film cannot easily adhere.

These are all desired effects. They are aids to Nature which authorities approve. See how they chang your tooth conditions in this ten-day test.

You are welcome to this test

A 10-Day Tube of Pepsodent is sent to all who ask. It is bringing a new dental era, and we want you to know the facts.

The fight on film

Pepsodent results from many years of effort to fight film on teeth. Film is that viscous coat you feel. It clings to teeth, enters crevices and stays. The ordinary tooth paste does not end it, so film-caused troubles have been constantly increasing.

Film is what discolors, not the teeth. Film is the basis of tartar. It holds food substance which ferments and forms acid. It holds the acid in contact with the teeth to cause decay.

Millions of germs breed in it. They, with tartar, are the chief cause of pyorrhea. Thus most tooth troubles are now traced to film.

Now dental science has found ways to fight it. These methods are embodied in Pepsodent. Five years of tests have amply proved it. The highest authorities today endorse its principles. Millions now employ it.

Send the coupon for a 10-Day Tube. Note how clean the teeth feel after using. Mark the absence of the viscous film. See how teeth whiten as the film-coat disappears.

The book we send explains the reasons for its multiple effects. See and feel them, then judge for yourself how much they mean to you and yours. Cut out the coupon now.

Pepsodent PAT. OFF. REG. U.S.

The New-Day Dentifrice

A scientific film combatant combined with two other modern requisites. Now advised by leading dentists everywhere and supplied by all druggists in large tubes.

10-Day Tube Free 522

THE PEPSODENT COMPANY,
Dept. 181, 1104 S. Wabash Ave.,
Chicago, Ill.

Mail 10-Day Tube of Pepsodent to

.....

.....

Only one tube to a family

PERFECT SALES CO., 140 W. Mayfield Ave., Dept. 45, Chicago, Ill.

Your Choice 75c a Week

FREE!
With every set is included—FREE—a Consulting Membership which gives you the privilege of submitting your perplexing problems to a corps of experts for an entire year. This Consulting Membership regularly sells for $12.00.

No matter what your occupation, one of the home study sets listed below will quickly fit you for a better job and bigger pay. Any set you select will be sent for seven days' examination, and if you decide to buy you may pay the rock-bottom price at the rate of **only 75c a week.** But you must act now! The rising cost of paper and binding materials won't permit us to continue the present low prices much longer.

These books are the work of recognized authorities. They are written in plain, easily understood language, by recognized authorities, and contain hundreds of photographs, diagrams, tables, etc., that make difficult points as simple as A-B-C. Handsomely and durably bound in half or full morocco leather (except as noted), and stamped in gold.

Pay-Raising Books

At Greatly Reduced Prices

Accountancy and Business Management, 7 vol., 2700 pages, 1000 pictures. Was $52.50 ..... Now $29.80
Carpentry and Contracting, 5 volumes, 2138 pages, 1000 pictures. Was $37.50. Now 24.80
Civil Engineering, 9 volumes, 3900 pages, 3000 pictures. Was $67.50 ..... Now 39.80
Electrical Engineering, 8 volumes, 4100 pages, 3300 pictures. Was $60.00 ... Now 34.80
Automobile Engineering, 6 volumes, 2600 pages, 2000 pictures. Was $45.00.... Now 29.80
Machine Shop Practice, 6 volumes, 2300 pages, 2500 pictures. Was $45.00... Now 29.80
Steam and Gas Engineering, 7 volumes, 3300 pages, 2500 pictures. Was $52.50, Now..... 29.80
Law and Practice (with reading course), 13 volumes, 6000 pages, illustrated. Was $97.50..... Now 49.80
Fire Prevention and Insurance, 4 vols., 1500 pages, 600 pictures. Was $30.00 Now 19.80
Telephony and Telegraphy, 4 volumes, 1728 pages, 2000 pictures. Was $30.00 Now 19.80
Sanitation, Heating and Ventilating, 4 volumes, 1454 pages, 1400 pictures. Was $30.00..... Now 18.80
Drawing, 4 volumes, 1578 pages, 1000 pictures, blue-prints, etc. Was $30.00... Now 19.80

Send No Money

Shipped for 7 Days' Trial

Yes, we'll gladly ship any set right to your home or office upon your simple request. Pay only shipping charges when the books arrive. Don't send a penny until after you have used them seven days, then remit only $2.80 or return them at our expense. Pay balance at the rate of $3.00 a month—**75c a week.**

Act now—while these splendid books are being offered at 20% to 50% less than regular prices. This offer is open to every person within the boundaries of the U. S. and Canada. Grasp your opportunity—**fill in and mail this coupon NOW!**

American Technical Society, Dept. X201, Chicago

American Technical Society, Dept. X201, Chicago, U. S. A.

Please send me set of .....?

.....

for 7 DAYS' examination, shipping charges collect. I will examine the books thoroughly and, if satisfied, will send $2.80 within 7 days and $3 each month, until I have paid the special price of ..... If I decide not to keep the books, I will notify you at once and hold them subject to your order. Title not to pass to me until the set is fully paid for.

NAME .....

ADDRESS .....

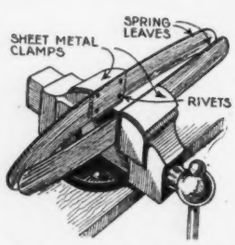
REFERENCE .....

other end of the condenser tube and run it to a clean glass receptacle. Pass a small stream of cold water through the condenser by connecting the lower of the short glass tubes with a hydrant and the upper to a drain. Just open the faucet enough to keep a small, easy stream of cold water passing through the condenser and out of the drain hose.

The steam from the boiler passes through the condenser and becomes condensed in the tubes chilled by the flowing water. The pure distilled water is collected in the receptacle as shown.—FRANCIS DASHIELL.

To Hold a Saw in a Vise with Spring Leaves

TWO leaves from an automobile spring form a desirable adjunct to the vise when saw filing or when filing the edges of sheet metal. These may have vise jaw clamps of sheet iron riveted on them to make them hold properly in the vise while arranging the saw for filing or clamping the sheet metal in place. These old spring blades are procurable from the pile of discards about the garage in lengths of three feet or more.



The two spring leaves will hold the saw for filing

They are curved in shape and, due to their meeting at the extreme tips first, will clamp the part solidly and afford sufficient rigidity to permit of filing the parts freely.—G. A. LUERS.

A Novel Pen-Rack for the Writing-Desk

AN attractive pen-rack that any one would value can be made from an old horseshoe. Get the horseshoe and, if it is dirty, clean it well. Should there be a rusty, uneven surface on it, this must be smoothed down with emery - paper. There is no need, however, to get the horseshoe really bright.

You will now need six rather short nails bent slightly upward. It is quite easy to bend these with a pair of pliers, and you should try to get them all with about the same curve. You must now get a much longer nail, one that is almost six inches long being the best. If you cannot secure so long a nail, a piece of stout wire would do as well. This long nail or piece of wire is curved

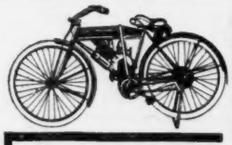
An old horseshoe makes an attractive pen-rack for the writing-desk

MIKE GIBBONS' Famous Home Course

Learn Scientific Boxing in your own home. Thousands are now doing it. Just send me your name, age, occupation and address and I will send you my Free Booklet explaining exactly what my course contains.

Dept. W
Gibbons Athletic Association
Metropolitan Theatre Bldg.
ST. PAUL MINNESOTA

In SCIENTIFIC BOXING



90 to 125 Miles on a Gallon of Gasoline!

The Shaw Motorbicycle

A high-grade, easy running, speedy motorbicycle of dependable power at a saving of from a third to a half in actual money. Equipped with 2½ H-P Motor, famous Breeze carburetor, high tension magneto. Automatic lubrication. Chain drive. Simple, efficient control at all times. Thousands in use.

Write today for prices and terms, also about the Shaw Attachment—fits any old bike.

SHAW MANUFACTURING CO.
Dept. 461, GALESBURG, KANS.

Shoot Without Noise

Avoid disturbance, also flinching. Enjoy quiet shooting, anywhere, anytime.

Use the new Model 1920
MAXIM SILENCER
Price, .22 cal. $7.00
All larger calibers $10.00.
Send 6c in stamps for catalog and BOOKLET of astonishing experiences of Silencer users.

The Maxim Silencer Co.
91 Homestead Ave.
Hartford, Conn.

Oh Boy! Build This Car

This nifty little car driven by gasoline motor, can be built by any boy. Parts are furnished by us and are very cheap. Send 10c for building plans and price list of parts showing how to build this lad's car

SYPHER MFG. CO., 174 Sypher Bldg., Toledo, Ohio

Learn to Dance

You can learn Fox-Trot, One-Step, Two-Step, Waltz and latest "up-to-the-minute" society dances in *your own home* by the wonderful Peak System of Mail Instruction.

New Diagram Method. Easily learned; no music needed; thousands taught successfully; success absolutely guaranteed.

Write for Special Terms. Send *today* for FREE information and surprisingly low offer

WILLIAM CHANDLER PEAK, M. B.
Room 117 821 Crescent Place, Chicago, Ill.

Here's the reason I wanted The Auto-Wheel CONVERTIBLE Roadster

SEE how these sides work?—When I spread them out I have a hauling wagon. Just see how strong it is. Now suppose I want to coast, I push the sides towards the center. (They swing on pivots). Look at that roadster. Built just right. Wheels have real roller-bearings. No other wagon like it.

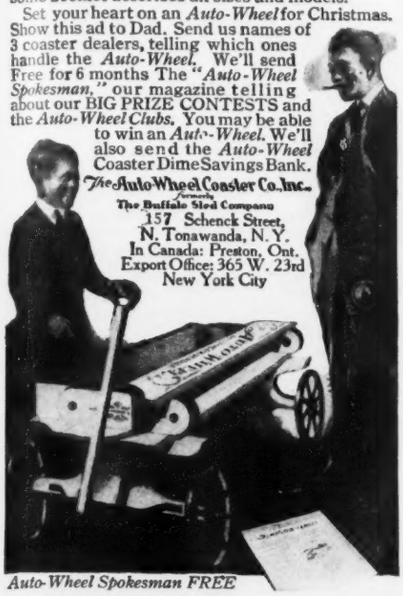
"And maybe you think it doesn't travel.—I'll challenge any boy on this street to a race."

The Perfect Christmas Gift

An *Auto-Wheel* wagon is a year-'round pal. You'll enjoy it throughout your boyhood. Besides the *Auto-Wheel Convertible Roadster*, we make the *Auto-Wheel Coaster*, the all-purpose wagon. Handsome booklet describes all sizes and models.

Set your heart on an *Auto-Wheel* for Christmas. Show this ad to Dad. Send us names of 3 coaster dealers, telling which ones handle the *Auto-Wheel*. We'll send Free for 6 months The "*Auto-Wheel Spokesman*," our magazine telling about our BIG PRIZE CONTESTS and the *Auto-Wheel Clubs*. You may be able to win an *Auto-Wheel*. We'll also send the *Auto-Wheel* Coaster Dime Savings Bank.

The Auto-Wheel Coaster Co. Inc.
Formerly
The Buffalo Sled Company
157 Schenck Street,
N. Tonawanda, N. Y.
In Canada: Preston, Ont.
Export Office: 365 W. 23rd
New York City



Auto-Wheel Spokesman FREE

Wool Army Shirts

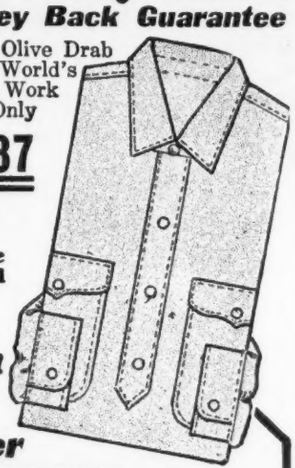
Money Back Guarantee

Genuine Olive Drab All Wool World's Greatest Work Shirt! Only

$2.87

Postage Prepaid

A Real Bargain!



Order Several Now!

No. 200—Wool Army Shirts. Regulation U. S. Army Olive Drab. Breast interlining. Reinforced elbows. Double sewed seams. Made of best wool shirting. Thoroughly laundered and repaired. New ones cost over $8.00 Big shipment just received—but they'll go quickly. Money refunded if not satisfactory. **Order at once.**

FREE BIG BOOK of New and Used Army Goods. Write!

Price each, delivered prepaid, only $2.87

CARNIE - GOUDIE CO.
Dept. K S, Kansas City, Mo.

New Big No. 14-200 pp. Wireless and 100 pp. Electrical Catalog

Wireless catalog mailed for 12c and electrical catalog for 6c. You may deduct this amount on first $1.00 purchase. Catalog not sent otherwise. Any wireless amateur will tell you it is the one catalog to have. As an encyclopedia of information it is invaluable. The largest and most elaborate radio catalog published. Values that cannot be duplicated elsewhere.

THE WILLIAM B. DUCK COMPANY
212-214 Superior St. TOLEDO, OHIO

as shown in the illustration, so as to form a support for the rack. The six small nails are soldered into the holes, three on each side. The big nail is then put in on the other side so that it forms a brace. It should be arranged in such a way that when it touches the table, the horseshoe is held nearly upright. When all this is completed, the whole of the pen-rack may be painted. Paint of any color may be used.—S. LEONARD BASTIN.

Remodeling a Plain Piece of Furniture

WITH a little mechanical skill and a few carpenter tools a commonplace and unornamental piece of furniture may be remodeled into an attractive and useful object fit for any room. The accompanying illustration shows how an exceedingly plain and unprepossessing bureau was transformed into a handsome and artistic buffet.

The bureau originally had three plain drawers with varnished natural wood fronts. The top drawer was

This shows what may be done with a little skill and a few tools

removed together with the partition between it and the middle drawer, which was also discarded. From the material contained in the top drawer a small drawer was made, supported by brackets as shown in the illustration.

The space previously occupied by the middle drawer was made a shelf by polishing and varnishing the partition board on which it had rested. The bottom drawer was also removed and from the front board of it a double door was made for the bottom compartment. Ornamental hinges and keyhole escutcheons enhanced the antique appearance of the buffet.

How Ford Springs May Be Oiled Easily

I MADE a set of spring oilers that proved very efficient for our Ford car. I took newspapers and cut them about four inches wide and the same length as one side of the spring. Then I cut little slots in the paper where the

The Hour That Counts!

When you see a man putting in his noon hour learning more about his work, you see a man who won't stay down. He'll never be satisfied until he hits the top. And he'll get there!

In shops, factories, offices, stores, in every line of industry, men are holding splendid positions won through spare time study with the International Correspondence Schools. Today they are earning four or five times—yes, some of them *ten* times as much money as when they started.

Employers everywhere are looking for men who really want to get ahead. If *you* want to make more money, show your employer that you're trying to be *worth* more money.

For 29 years the International Correspondence Schools have been training men and women right in their own homes.

More than two million have stepped up in just this way. More than 130,000 are studying now. Can you afford to let another hour pass without making *your* start toward something better? Here is all we ask—without cost, without obligation, mark and mail this coupon!

TEAR OUT HERE

INTERNATIONAL CORRESPONDENCE SCHOOLS
BOX 7608-B, SCRANTON, PA.

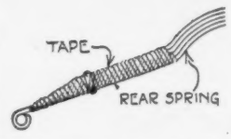
Explain, without obligating me, how I can qualify for the position, or in the subject, *before* which I mark X.

☐ ELECTRICAL ENGINEER	☐ SALESMANSHIP
☐ Electric Lighting and Rys.	☐ ADVERTISING
☐ Electric Wiring	☐ Window Trimmer
☐ Telegraph Engineer	☐ Show Card Writer
☐ Telephone Work	☐ Sign Painter
☐ MECHANICAL ENGINEER	☐ Railroad Trainman
☐ Mechanical Draftsman	☐ ILLUSTRATING
☐ Machine Shop Practice	☐ Cartooning
☐ Toolmaker	☐ BUSINESS MANAGEMENT
☐ Gas Engine Operating	☐ Private Secretary
☐ CIVIL ENGINEER	☐ BOOKKEEPER
☐ Surveying and Mapping	☐ Stenographer and Typist
☐ MINE FOREMAN or ENG'R	☐ Cert. Pub. Accountant
☐ STATIONARY ENGINEER	☐ TRAFFIC MANAGER
☐ Marine Engineer	☐ Railway Accountant
☐ Ship Draftsman	☐ Commercial Law
☐ ARCHITECT	☐ GOOD ENGLISH
☐ Contractor and Builder	☐ Teacher
☐ Architectural Draftsman	☐ Common School Subjects
☐ Concrete Builder	☐ CIVIL SERVICE
☐ Structural Engineer	☐ Railway Mail Clerk
☐ PLUMBING AND HEATING	☐ AUTOMOBILE OPERATING
☐ Sheet Metal Worker	☐ Auto Repairing
☐ Textile Overseer or Supt.	☐ Navigation
☐ CHEMIST	☐ AGRICULTURE
☐ Mathematics	☐ Poultry Raising
	☐ Spanish
	☐ French
	☐ Italian

Name_____
Present Occupation_____
Street and No._____
City_____ State_____

Canadians may send this coupon to 7-28-10
International Correspondence Schools, Montreal, Canada

clips hold the spring together and made the paper fit snugly around the springs. From paper patterns I cut covers of black muslin. Then I made covers out of some side curtains from an old car. I got an old woolen blanket and cut it in strips that were about the same width and length as the spring, and I sewed them together—about five thicknesses in all.



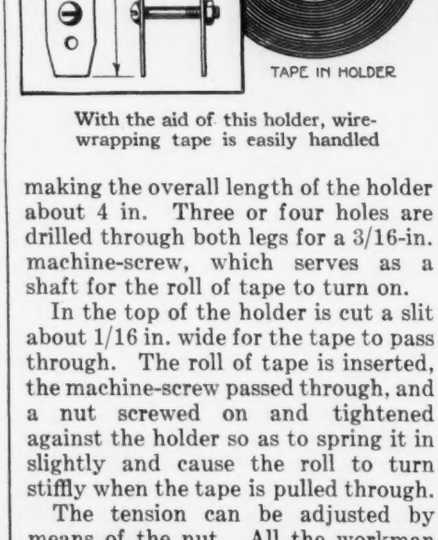
Well wrapped and oiled springs will not squeak

I soaked these in cylinder oil for about fifteen minutes and then laid them flat on the top of the springs. The muslin cover was first wrapped around the spring and next the old side-curtain cover. I wound friction tape around this to hold it in place. The only care I give to the springs is to pour about two tablespoonfuls of oil in the tops each month. The car rides better and squeaks are eliminated.

A Convenient Holder for Wire-Wrapping Tape

WHERE considerable work is done in taping up wire, coils, and so on, it is a great convenience and a time-saver to have a holder to carry the tape. The holder shown herewith not only keeps the tape clean and out of the way, but it permits winding with the least possible trouble.

A piece of strip brass ¾ in. wide and at least 1/16 in. thick is bent as shown,



With the aid of this holder, wire-wrapping tape is easily handled

making the overall length of the holder about 4 in. Three or four holes are drilled through both legs for a 3/16-in. machine-screw, which serves as a shaft for the roll of tape to turn on.

In the top of the holder is cut a slit about 1/16 in. wide for the tape to pass through. The roll of tape is inserted, the machine-screw passed through, and a nut screwed on and tightened against the holder so as to spring it in slightly and cause the roll to turn stiffly when the tape is pulled through.

The tension can be adjusted by means of the nut. All the workman has to do is to wind the tape running out as it is used.

DIRECT FROM THE FACTORY
TO YOU FOR $13.50

This genuine waterproof raincoat, combining all qualities of the highest-grade garment, the final achievements in style, durability, ventilation, design and material, **DIRECT FROM THE FACTORY TO YOU BY PREPAID INSURED PARCEL POST.**

With the signing of the armistice and termination of our Government contracts, we found ourselves stocked with a large supply of material and, having lost our civilian patronage, we decided to sell

PEERLESS RAINCOATS

direct from the factory to you. Man's model shown is double-breasted, with inverted pleat down back, belt all around, buckled wrist fastenings, outside patch pockets, convertible collar and built so that NO WET CAN GET THRU.

AN IDEAL CHRISTMAS GIFT

Here's your chance to get a bargain for yourself or an ideal Christmas gift for your relatives or friends. A gift of this kind is sensible, inexpensive and bound to be appreciated by the recipient. Upon receipt of your remittance and instructions, we will send a Peerless Raincoat direct to the desired person for Christmas morning.

We still have a limited supply of last issue regulation ARMY RAINCOATS which we are closing out at $8.50. Also Woman's Model, $12; Boys' and Girls' Model, $7. Belted leatherette coats for men and women, $24. When ordering state chest measurement.

Satisfaction Guaranteed or Money Back

Order NOW direct from

The Peerless Company

Dept. 2A 80 BRANFORD PLACE, NEWARK, NEW JERSEY

AGENTS WANTED

Learn Mechanical Drawing

EARN $35 TO $100 A WEEK AS AN EXPERT DRAFTSMAN

We will train you by mail, in your own home through our practical Home Study Course in Mechanical Drafting. By our improved method you will learn Drafting as you would in actual practice in any big drafting department. When you finish this course you will be qualified, as an experienced draftsman, to step into a position paying $35 to $50 a week to start with opportunities for advancement to position of Chief Draftsman paying $5,000 or more a year. The practical knowledge of drafting which we will give you may prove the stepping stone to position as Chief Engineer or Manager of Production at a much higher salary. Our graduates are always in demand. Big concerns employ them regularly at good salaries, because they KNOW—because we produce first-class professional Draftsmen.

WRITE TODAY FOR FREE CATALOG

telling what we have done for others and what we can do for you. It will open your eyes to Your Future in Drafting.

ROY C. CLAFLIN, Pres.,
COLUMBIA SCHOOL OF DRAFTING,
Dept. 1204, Washington, D. C.

Tire Agent

We want one exclusive representative in each locality to use and sell the new Mellinger Extra-Ply, hand made tires. **Guarantee Bond for 6000 Miles.** (No seconds). Shipped prepaid on approval. Sample sections furnished. Do not buy until you get our Special Direct Prices. Write

MELLINGER TIRE & RUBBER CO.
1004 Oak St., Kansas City, Mo.

Why use Coal or Wood?

Just turn a valve to cook or heat

THE OLIVER OIL-GAS BURNER

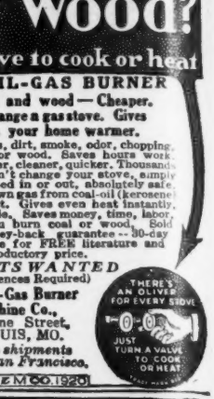
Does away with coal and wood—Cheaper. Makes your stove or range a gas stove. Gives more heat. Keeps your home warmer.

No fires to make. No ashes, dirt, smoke, odor, chopping, shoveling—carrying coal or wood. Saves hours work. Makes your stove bake better, cleaner, quicker. Thousands in use over 10 years. Doesn't change your stove, simply sits in fire box, easily slipped in or out, absolutely safe. Lasts lifetime. Makes its own gas from coal-oil (kerosene) at small cost. Gives even heat instantly, much or little. Saves money, time, labor, whether you burn coal or wood. Sold under money-back guarantee—30-day trial. Write for FREE literature and special introductory price.

AGENTS WANTED
(References Required)

Oliver Oil-Gas Burner & Machine Co.,
2007 Pine Street,
ST. LOUIS, MO.

Western shipments from San Francisco.



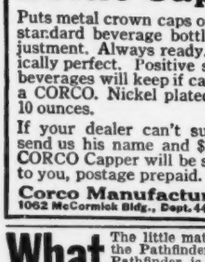
© OO-GB EM CO. 1920

World's Best Roofing at Factory Prices

"Reo" Cluster Metal Shingles, V-Crimp, Corrugated, Standing Seam, Painted or Galvanized Roofings, Sidings, Wallboard, Paints, etc., direct to you at Rock-Bottom Factory Prices. Positively greatest offer ever made.

Edwards "Reo" Metal Shingles

cost less; outlast three ordinary roofs. No painting or repairs. Guaranteed rot, fire, rust, lightning proof.



Free Roofing Book

Get our wonderfully low prices and free samples. We sell direct to you and save you all in-between dealer's profits. Ask for Book No. 198.

LOW PRICED GARAGES

Lowest prices on Ready-Made Fire-Proof Steel Garages. Set up any place. Send postal for Garage Book, showing styles.

THE EDWARDS MFG. CO.,
148-196 Pike St., Cincinnati, O.

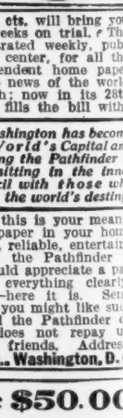
FREE Samples & Roofing Book

An Easy Squeeze

With a

CORCO Bottle Capper

Puts metal crown caps on any size standard beverage bottle. No adjustment. Always ready. Mechanically perfect. Positive seal. Your beverages will keep if capped with a CORCO. Nickel plated—weight 10 ounces.



If your dealer can't supply you, send us his name and $2.50 and a CORCO Capper will be sent direct to you, postage prepaid.

Price $2.50

Corco Manufacturing Co.
1062 McCormick Bldg., Dept. 441, Chicago

What a Dime Will bring You From the Nation's Capital

The little matter of **10 cts.** will bring you the Pathfinder **eight** weeks on trial. The Pathfinder is an illustrated weekly, published at the Nation's center, for all the Nation; an independent home paper that prints all the news of the world and tells the truth; now in its 28th year. This paper fills the bill without emptying the purse; it costs but $1 a year. If you want to keep posted on what is going on in the world, at the least expense of time or money, this is your means. If you want a paper in your home which is sincere, reliable, entertaining, wholesome, the Pathfinder is yours. If you would appreciate a paper which puts everything clearly, strongly, briefly—here it is. Send 10c to show that you might like such a paper, and we will send the Pathfinder on probation **eight** weeks. The 10c does not repay us, but we are glad to invest in new friends. Address:

Washington has become the World's Capital and reading the Pathfinder is like sitting in the inner council with those who mold the world's destiny.

THE PATHFINDER. 486 Langdon Sta., Washington, D. C.

You Can Save $50.00

$8.46 and up
Parcels Post Paid

By recovering your old auto top frame yourself. We make these recovers to fit all makes and models of cars. Any person that can drive a car can put it on. We furnish instructions. Roof and quarters sewed together with rear curtain, fasteners, welts and tacks. All complete. Give us the name, year and model number of your car and we will send you our catalogue with samples and quote you exact price.

LIBERTY TOP & TIRE CO., Dept. E8, Cincinnati, O.

BE AN
AUTOMOTIVE
EXPERT!

EXPERT Automobile and Tractor Mechanics are in demand everywhere. Well trained men earn big money. YOU can qualify for these positions. We teach you by daily actual practice under skilled instructors. Experience in training thousands of mechanics for U. S. Government. Course include all branches of automobiles, tractors, welding and tire vulcanizing. Day or evening classes. Our free catalog tells how we train men to occupy expert automotive positions. Send for your copy now.

Motor Institute, Inc.
2698 University Avenue S. E.
Minneapolis, Minn.

Old Style Shaving Best Of All

Every man knows that **Old Style** Shaving is best—but few know how to keep the **Old Style Razor** in good condition. Just plain stropping will not produce a perfect cutting edge—a good honing once a week followed by a good stropping makes for real shaving comfort.

The Hone-Your-Own RAZOR-HONE

is the only hone that the inexperienced man can use without fear of over-honing—the holes (patented) automatically remove the rough, scratchy edge that makes the Old Style Razor pull. These holes shear off every particle of "Wire-Edge."

TRY ONE 30 DAYS

If it fails to do exactly what we claim—to make your favorite old razor shave like new—return it at our expense. Your money cheerfully refunded. All good hardware and drug dealers carry **Perforated Hones**—if yours is not yet supplied, send $1.00 direct to us with your dealer's name.

PERFORATED HONE CO., 314 Hammond Bldg.
DETROIT, MICHIGAN

Free Book
Containing complete story of the origin and history of that wonderful instrument—the
SAXOPHONE

Easy to Play
Easy to Pay

This book tells you when to use Saxophone—singly, in quartettes, in sextettes, or in regular band; how to transpose cello parts in orchestra and many other things you would like to know.

You can learn to play the scale in one hour's practice, and soon be playing popular airs. You can double your income, your pleasure, and your popularity. Easy to pay by our easy payment plan.

MAKES AN IDEAL PRESENT

Send for free Saxophone book and catalog of everything in True-Tone band and orchestra instruments

BUESCHER BAND INSTRUMENT CO.
314 Buescher Block, Elkhart, Ind.

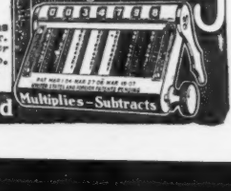
LEARN ENGINEERING

Expert electrical engineers are being paid fabulous salaries. Thousands needed today. We give you personal and thorough training—practical, technical, courses three months to two years, under expert engineers in electricity, steam, gas, auto, armature winding, drafting, etc. Extensive laboratory and shop equipment. Not a trade school. Enroll anytime. Do not judge us by size of ad but write for free illustrated catalogue.

FINDLAY ENGINEERING COLLEGE
Greatest of its kind
1001 Indiana Avenue — Kansas City, Mo.

SUPERIOR SINCE 1904
Over 100,000 in Use
Mostly sold through recommendation
For Personal Desk or General Office
It checks mental calculations
Buy through your stationer.
Write for 10-day Trial Offer
P. E. Gancher, A. A. M. Co.
148 Duane St., New York
Canadian Agency

Golden Gem PORTABLE Adding Machine $15



Agents Wanted
Multiplies—Subtracts

How Window-Washing Can Be Made Less Irksome

WINDOW-WASHING is not usually considered a pleasant pastime, particularly in winter. It is decidedly unpleasant work. One of its most annoying features is the discomfort caused by the water running down the arm when it is extended for the purpose of washing the upper part of a window-pane. One ingenious janitor found a simple method of preventing this particular annoyance by

One of these wrist cups will keep the water from running down your arm

placing a rubber washer on the wrist of his right arm, as shown in the accompanying illustration.

He cut a circular piece, about 5 in. in diameter, from an old inner tube of an automobile tire. Then he cut a hole in the center, slightly smaller in diameter than his wrist. When the washer was placed on the wrist, it fitted tightly and caused the disk of rubber to form a cup that would catch the water squeezed out of the sponge or cloth that otherwise would have run down the arm. The water was emptied from time to time.—DALE VAN HORN.

Saving Time by Using a New Adjustable Wrench

LITTLE time is wasted in setting the wrench shown in the accompanying illustration to fit nuts or bolt-heads of different sizes. Pulling out a little knob will release the grip of the jaws of the wrench after you have completed your work.

The movable jaw of the wrench has at the end nearest to the handle a little catch that is pressed by a spring

Don't Grope for Words

Give Grenville Kleiser (famous Speech Specialist) 15 minutes daily

He Will Give You a Mastery of Words

There are no old-fashioned, wearisome rules of grammar to memorize. By an entirely new plan you absorb and immediately apply the fruits of years of teaching experience which are compress into twenty intimate home lessons.

If you will devote 15 minutes daily to this original Course you will quickly and surely learn to

Enlarge Your Stock of Words—
Use the Right Word in the Right Place—
Write Tactful, Forceful Letters, Advertisements, Stories, Sermons, Treatises, Etc.—
Become an Engaging Conversationalist—
Enter Good Society—
Be a Man of Culture, Power, and Influence in Your Community.

Booth Tarkington

Distinguished Novelist and Short Story Writer, Author of "Monsieur Beaucaire," "Seventeen," etc.

"Your course is almost painfully needed by many professional writers and speakers. A student who intelligently follows your course will know what he is talking about when he talks or when he writes. His audience will certainly know because he will talk well, no matter what his subject."

Mary Roberts Rinehart

Eminent Novelist, Dramatist, and War-Correspondent, Author of "K," "Kings, Queens and Pawns," etc.

"Your lessons seem to me excellent for the purpose. Also the selection of books for study appeals to me very strongly. It looks like a scholarly and most intelligently compiled course of instruction and writing.

FREE

"How to Become a Master of English"

We want you to read this booklet that you may understand what the course will do for you, the real practical help it will give you in a hundred different ways. Obtain a mastery of English and realize your own possibilities. Be yourself at your best. It means more money, more power, more life in every way.

SIGN AND MAIL THIS COUPON *NOW*

FUNK & WAGNALLS COMPANY
Dept. 460, New York

Please send by mail Booklet and full information regarding Grenville Kleiser's Correspondence Course in Good English.

Name.....

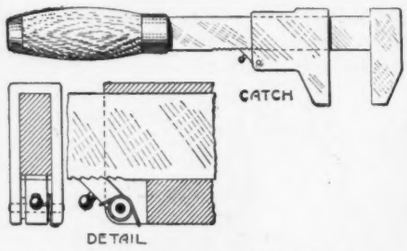
Local Address.....
Street and Number or R. F. D.

Post Office.....

Date.....*State*.....

against the ratchet teeth cut into the side of the wrench-bar.

If you wish to use the wrench, bring the fixed jaw with its inner side against one of the flat sides of the nut or bolthead, slide the movable jaw toward the nut until it is pressed firmly against the opposite flat surface, and let the catch engage the teeth of the ratchet. The jaws will hold the nut or bolthead



Push the jaws against opposite sides of the nut and the catch will hold them tight until released

firmly until they are released by the disengaging of the catch.

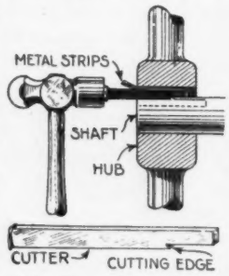
There is no screw to turn or other complicated and time-consuming operation to be performed to secure a firm grip.—CHARLES SCHADEL.

Cutting Large Keyways by Hand

A NUMBER of large keyways had to be cut in heavy shafts in a shop that had no machine that would do the work, and it was necessary to devise a method on the spot. The problem was solved in the following ingenious way:

A steel tool was made the same width as the keyway, with a cutting edge on one side.

The wheel was placed on the shaft with the wheel keyway, which was already cut, in its proper position. The tool was about 1/32 in. deeper than the keyway in the wheel hub. It was inserted and driven through with a hammer, and as it went through it cut a shallow groove on the shaft. It was then sent through again, this time with a strip of sheet iron on top, which forced it to take another cut.



Nothing simpler than cutting keyways in this way

This process was repeated until the cut reached the desired depth. Instead of using a large number of very thin strips to cause the tool to feed, heavy strips were used as the cut went deeper. The work was done in a shorter time than would seem possible. In fact, the scheme was so successful, that the shop later rigged up a false hub so that keyways could be cut without the wheel being in place, and a false shaft for cutting keyways in hubs.

PATENTS

IF YOU HAVE AN INVENTION which you wish to patent you can write fully and freely to Munn & Co. for advice in regard to the best way of obtaining protection. Please send sketches or a model of your invention and a description of the device, explaining its operation.

All communications are strictly confidential. Our vast practice, extending over a period of seventy years, enables us in many cases to advise in regard to patentability without any expense to the client. Our Hand-Book on Patents is sent free on request. This explains our methods, terms, etc., in regard to Patents, Trade Marks, Foreign Patents, etc.

If you are a reader of

SCIENTIFIC AMERICAN

you are probably aware of the fact that it has a special appeal to the inventor. Each issue contains a description of a large number of recently patented inventions. Pending patent legislation as well as the most recent rulings of the Patent Office and the courts are considered in its columns.

MUNN & CO.

SOLICITORS OF PATENTS

683 Woolworth Building, New York
624 F Street, Washington, D. C.
Tower Building - Chicago, Ill.
Hobart Bldg., 582 Market Street, San Francisco, Calif.

CAN YOU

think of a simple, practical idea that will fill one of the many requests we have on file for new inventions? It may mean a fortune for you. Thousands of things are needed RIGHT NOW. YOUR brains can help. Send today for our great new book—"Inventions and Trade Marks, Their Protection and Exploitation" and learn more about making money from ideas than you ever knew before. It tells many things that are wanted, too. A postal will do—it is free.

We help our clients, without charge, to get the dollars out of their ideas—having facilities none others possess.

Advice free.

Don't delay—get the book at once.

AMERICAN INDUSTRIES, INC.

201 Patent Dept., WASHINGTON, D. C.

PATENTS ADVERTISED For SALE FREE In INVENTION And MANUFACTURING SUPPLEMENT.

Published for the man with an idea Send for free sample copy. One year's subscription 50c.

$4 or $5 a month WILL BUY
A Standard, Guaranteed
TYPEWRITER
With Every Modern Writing Convenience
Write Today For Illustrated Circular Explaining Try-Before-You-Buy Plan
SMITH TYPEWRITER SALES CO.
(Harry A. Smith) 306—218 No. Wells St., Chicago, Ill.

PATENTS

Free Book on Patents

Before applying for a patent write for a Free Copy of our book "How to Obtain a Patent," which contains valuable information and advice to inventors. It tells how to secure Patents. Send a model or sketch of your invention for our "Evidence of Conception" form and our opinion of its patentable nature—Free. Twenty years' experience in patent matters.

Write today for your FREE BOOK.

TALBERT & TALBERT
Patent Lawyers
4849 Talbert Bldg., WASHINGTON, D. C.

PATENTS

Booklet Free — Highest References
Promptness Assured — Best Results

Send drawing or model for preliminary examination of Patent Office records and report as to patentability

All Business Given Prompt and Proper Attention

WATSON E. COLEMAN, Patent Lawyer.
624 F St., Washington, D. C.

I. T. S. Patents

Five years ago, practically without capital, J. G. Tufford, Elyria, Ohio, and his associates Smith and Ingwer started business with the now well-known I. T. S. Rubber Heel under the Tufford U. S. and foreign patents obtained through Lacey & Lacey.

Fourteen tons of these heels are now produced daily. The profits already amount to many hundreds of thousands of dollars and foreign patents have been sold to the extent of $550,000.00.

That demonstrates the financial possibilities even of an extremely simple invention of merit properly patented. Read

PATENT-SENSE
SIXTH EDITION
"The Book for Inventors & Mfrs."
By Return Mail FREE. Write
LACEY & LACEY. Dept. F-S Washington, D.C.

Deafness

Perfect hearing is now being restored in every condition of deafness or defective hearing from causes such as Catarrhal Deafness, Relaxed or Sunken Drums, Thickened Drums, Roaring and Hissing Sounds, Perforated, Wholly or Partially Destroyed Drums, Discharge from Ears, etc.

Wilson Common-Sense Ear Drums

"Little Wireless Phones for the Ears" require no medicine but effectively replace what is lacking or defective in the natural ear drums. They are simple devices, which the wearer easily fits into the ears where they are invisible. Soft, safe and comfortable. Write *today* for our 168 page FREE book on DEAFNESS, giving you full particulars and testimonials.

WILSON EAR DRUM CO., Incorporated
283 Inter-Southern Bldg. LOUISVILLE, KY.

WILLIAM C. LINTON
Consulting Engineer and Patent Attorney

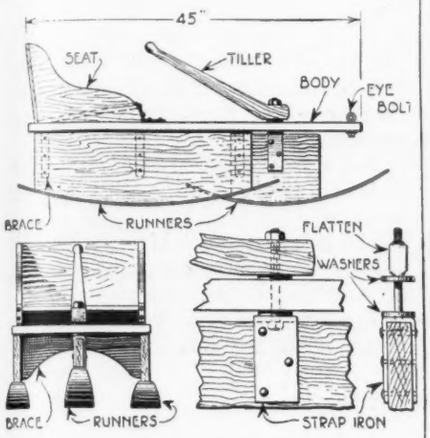
"Inventor's Adviser" Mailed free on request. Gives full information as to Patents, Trade Marks and Their Cost

OFFICES
364 UNIVERSITY ST., Montreal, Canada.
916 F ST. N. W., Washington, D. C.

Three-Runner Sled Made of Barrel Staves

A BARREL-STAVE sled fitted with a steering runner can be made by any one skilful with tools and will give much pleasure to the builder.

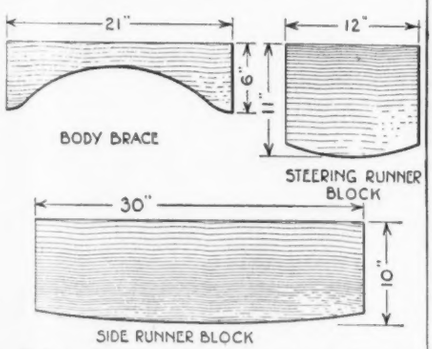
The body of the sled consists of a platform, 45 in. long by 24 in. wide, built of 1-in. boards. Probably at least three boards will be required and these are cleated together by three oak braces the shape and size shown in the



Boys clever with tools can easily make this sled from the drawings

detail sketch. Place across the body boards so 1½ in. will be left at each side.

Next, cut out two side-runner timbers of 1½-in. lumber 12 in. wide. Curve the bottom edge to the curve of a large barrel-stave, preferably one from a crockery barrel. This will make the centers 12 in. deep by 10 in. deep at the ends. Screw a stave to



Follow the lines and dimensions given here in cutting the runner blocks

each timber so the ends protrude the same distance at each end. Countersink the screwheads.

The steering runner is attached to a third block the same way. This block is only 12 in. long, 11 in. deep in the center, and 10 in. deep at the ends.

Now fasten the two side runners to the body, fitting them against the braces and under the body boards. This should bring them flush with the edge. Screw them to the braces and down through the body from the top.

Have a U-shaped iron strap made at the blacksmith's similar to the illustration. A heavy bolt should fit loosely in the center hole. Place this

PATENTS TRADE-MARKS AND COPYRIGHTS

SPECIAL OFFER FREE OPINION AS TO PATENTABLE NATURE

Before disclosing an invention, the inventor should write for our blank form **"Evidence of Conception."** This should be signed and witnessed and if returned to us together with model or sketch and description of the invention, we will give our opinion as to its patentable nature.

Our Three Books Mailed Free to Inventors

Our Illustrated Guide BOOK

HOW TO OBTAIN A PATENT

Sent FREE on Request

Contains full instructions regarding Patents, Trade-Marks, Foreign Patents. Our Methods, Terms, and 100 Mechanical Movements illustrated and described, Articles on Patent Practice and Procedure, and Law Points for inventors.

OUR TRADE MARK BOOK

Shows the value and necessity of Trade-Mark Protection and gives information regarding unfair competition.

OUR FOREIGN BOOK

We have Direct Agencies in all Foreign Countries. Write for our illustrated Guide Book on Foreign Patents.

SPECIALIZATION Our Staff

The field of invention is so vast that it is impossible for any one man to become an expert in all the different classes of invention. Only those practically skilled in the class to which the invention relates are capable of rendering efficient service. For this reason Victor J. Evans & Co. employ a number of patent lawyers and mechanical experts who have been selected for their special knowledge and ability in certain lines of invention. Each case is placed in charge of experts in the classes in which the invention relates.

THE VALUE OF YOUR PATENT

Will depend much upon the skill and care with which your case is prosecuted in the United States Patent Office. This work will receive the benefit of skill and experience acquired by a long and successful practice. We spare neither time nor pains to secure the broadest possible patents that the inventions will warrant. That every case entrusted to us receives our best efforts, and that our work is done consistently, skillfully and thoroughly is evidenced by the many unsolicited letters of commendation that we receive constantly from our clients. We will furnish upon request lists of clients from any State in the Union for whom we have secured patents.

Our New York, Philadelphia, Pittsburgh, Chicago, and San Francisco Offices

Owing to the growth of our business we have established for the benefit of our clients Branch Offices in New York City, Philadelphia, Pa., Pittsburgh, Pa., Chicago, Ill., and San Francisco, Cal. These branch offices being located in these large commercial cities, together with our Main Office located near the U. S. Patent office, in Washington, enables us to more promptly handle the business of our clients, particularly as the branch offices are in constant touch with the Main Office and fully equipped to handle patent business in all its branches.

Highest References—Prompt Attention—Reasonable Terms

FREE COUPON

VJE&Co

VICTOR J. EVANS & CO.
Patent Attorneys

New York Offices 1007 Woolworth Bldg. | Philadelphia Offices 135 S. Broad Street | Pittsburgh Offices 514 Empire Bldg.
Chicago Offices, 1114 Tacoma Bldg. | San Francisco Offices, Hobart Bldg.
Main Offices, 760 9th Street, Washington, D.C.

Gentlemen: Please send me FREE OF CHARGE your books as described above.

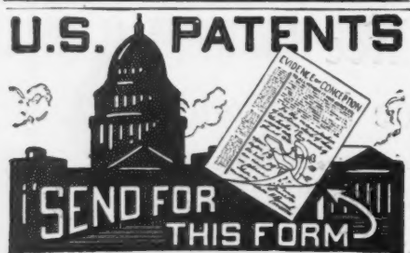
Name..... Address.....

PATENTS IF YOU HAVE AN INVENTION *and* DESIRE TO LEARN HOW TO SECURE A PATENT, send for Our Guide Book, **HOW TO GET A PATENT,** sent Free on request. Tells our Terms, Methods, etc. Send model or sketch and description of your invention and we will give our opinion as to its patentable nature.

RANDOLPH & CO.
130 F St., N. W., Washington, D. C.

NAME.....
STREET.....
CITY.....STATE.....

U.S. PATENTS



DON'T LOSE YOUR RIGHTS TO PATENT PROTECTION

Before disclosing your invention to anyone send for blank form **"EVIDENCE OF CONCEPTION"** to be signed and witnessed. A sample form together with printed instructions will show you just how to work up your evidence and establish the same before filing application for patent. As registered patent attorneys we represent hundreds of inventors all over the United States and Canada in the advancement of inventions. Our schedule of fees will be found reasonable. The form "Evidence of Conception," sample, instructions relating to obtaining of patents and schedule of fees sent upon request. Ask for them,—a post card will do.

PATENTS AND TRADE MARKS
LANCASTER & ALLWINE
274 Ouray Bldg.
WASHINGTON, D. C.
Originators of forms "Evidence of Conception"

PATENTS

To the Man With an Idea

I offer a most comprehensive, experienced, efficient service for his prompt, legal protection and the development of his proposition.

Send sketch, or model and description, for advice as to cost, search through prior United States patents, etc. Preliminary advice gladly furnished without charge.

My experience and familiarity with various arts, frequently enable me to accurately advise clients as to probable patentability before they go to any expense.

Booklet of valuable information and form for properly disclosing your idea, free on request. Write today.

RICHARD B. OWEN
Patent Lawyer
6 Owen Building, Washington, D.C.
2276-D Woolworth Building,
New York City

PATENTS
TRADE-MARKS COPYRIGHTS
Send for our free book of patent information
Beale & Park 804 F St., Washington, D. C. 16 S. Broad St., Philadelphia, Pa.

Convert Your Bicycle Into a Motor Cycle
By using a STEFFEY ATTACHMENT

Easy to attach. Fits the double-bar, arch or diamond frame. In successful use over 21 years. Send stamp at once for lowest factory prices.

STEFFEY MANUFACTURING CO.
Department S, 5025 Brown Street, Philadelphia, Pa.

Standard Underwoods
5-Year Guarantee

$5.00 DOWN

Yes, this genuine Standard Visible Writing Underwood, newly rebuilt, at much less than factory price, yours for $5.00 down and then easy monthly payments.

Factory Rebuilt

10 Days FREE Trial
Try it for 10 days at our risk. Money back guarantee. Send now for free book—bargain offer No. 14.

TYPEWRITER EMPORIUM, 14 Shipman Building
Montrose and Ravenswood Avenues Chicago, Illinois

SEXUAL KNOWLEDGE
ILLUSTRATED
By WINFIELD SCOTT HALL, M.D., Ph.D.
SEX FACTS MADE PLAIN
What every young man and Every young woman should know
What every young husband and Every young wife should know
What every parent should know
Cloth binding—320 pages—many illustrations
Table of contents, & commendations, on request

$1.00 Postpaid
Mailed in plain wrapper

AMERICAN PUB. CO., 117 Winston Bldg., Philadelphia

DIAMONDS ON CREDIT

Buy Holiday Gifts the Easy Way. Open a Charge Account with Loftis Bros. & Co.

Our large illustrated Catalog is your shopping guide to unusual bargains in handsome worth-while gifts on credit. Select as many articles as you wish and have all charged in one account. **Your** credit is good.

Credit Terms on purchases of $5 or over, one-fifth down, balance in eight equal amounts, payable monthly.

For Holiday Gifts

Most Popular Diamond Rings

WATCHES ON CREDIT

Send for Catalog

Whatever you select from our Catalog will be sent prepaid by us. **You see and examine the article right in your own hands** What could please a loved one more, or so well express your regard, as a beautiful Diamond Ring, La Vallière, Bar Pin, Brooch, Ear Screws, Wrist Watch, or a Diamond Scarf Pin, Diamond-set Emblem or Signet Ring, solid-gold Watch, etc. **Send for Catalog today. Liberty Bonds Accepted.**

LOFTIS BROS. & CO., The National Credit Jewelers
Stores in Leading Cities Dept. H-871 108 N. STATE ST., CHICAGO, ILL.

in with the head as shown and strap the whole superstructure to the steering-runner block at its center. The bolt is then passed through the hole in the body about a foot from the front and in the middle; a washer being placed above and below the body to prevent wear.

Cut a tiller out of hard wood, of the size and shape indicated in the illustration and place it over the projecting portion of the bolt. Then place on a nut and screw it tight, but be careful not to bind the bolt, for in that case it will not turn the steering runner.

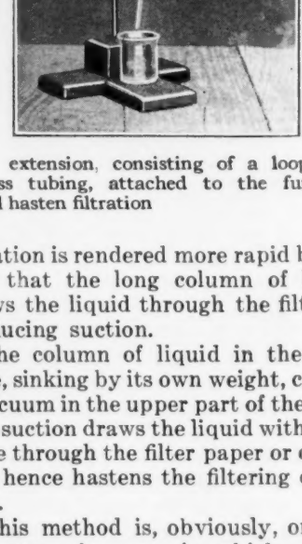
A seat somewhat like that shown in the side-view drawing will give comfort to the rider. This can be built of short ends of matched lumber and upholstered if desired.

Place an eyebolt in the front of the body to which a drag-rope may be attached.

The rider can seat himself comfortably in the seat and steer the sled by moving the tiller from side to side. This should be done gently, lest the runner act as a brake.—L. B. ROBBINS.

Filtering Rapidly with a Funnel Attachment

IN order to increase the speed of filtering, a thin glass tubing about a foot long is taken and bent so that a ring is formed near its upper end. This piece of glass tubing is then attached to the funnel with a piece of rubber. Fluids are filtered in the ordinary way, but



An extension, consisting of a loop of glass tubing, attached to the funnel will hasten filtration

filtration is rendered more rapid by the fact that the long column of liquid draws the liquid through the filter by producing suction.

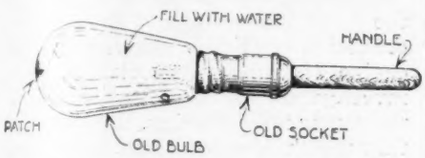
The column of liquid in the glass tube, sinking by its own weight, creates a vacuum in the upper part of the tube. The suction draws the liquid with great force through the filter paper or cotton and hence hastens the filtering operation.

This method is, obviously, only of advantage in cases in which considerable quantities of liquid are to be filtered. It will not prove efficient with small quantities.

loosely in the center hole. Place this

Making a Magnifying-Glass from an Old Bulb

ARE you a postage-stamp collector, a collector of geological, botanical, or entomological specimens? Or have you an amateur laboratory or workshop? For any one of these hobbies a magnifying-glass is useful, almost necessary in some cases. Don't go to a store and pay a few dollars for one, but make one for yourself and save money. The only materials needed



The bulb filled with water will act as a powerful magnifying-glass

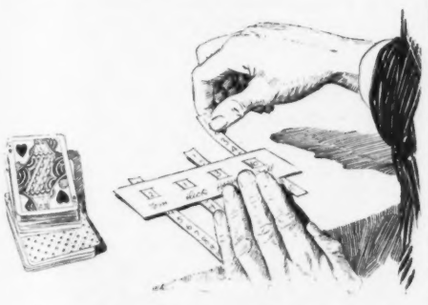
are a burnt-out incandescent lamp, a cast-off socket in which the bulb will fit, and a small piece of wood.

Immerse the lamp in a basin of water and cut off the small tip on the end of the bulb. The water will rush into the bulb and will not come out unless you jar it with the hole toward the floor. Seal the break in the lamp with sealing-wax or adhesive tape.

Take all the old wire and insulation out of the socket and screw it to the lamp. The taking out of the wire leaves a small hole in the socket. A piece of wood about 3 in. long, stuck into the hole in the socket, will serve the purposes of a handle. It should be sandpapered round. The handle and the socket may both be taped over if desired, and if not ornamental designs may be carved on the wooden handle.—A. GOLDENBAUM.

A Playing-Card Counter for a Friendly Game

A COUNTER for card games and the like can be made from a few strips of stiff paper. Cut as many strips, about 3/8 in. wide, as there are players. Cut a strip about 1 in. or wider—and rows of slits through



From a few strips of cardboard a neat and convenient counter may be made

which the narrow strips can be passed. The narrow strips are woven through the slits as shown, and the requisite numbers marked on them. The numbers show in succession as the strips are pulled through the respective slits.—HOWARD GREENE.

PATENTS

Record your idea by sending for blank form "Record of Invention," before filing your application for patent.

Send Sketch or Model for Preliminary Examination

Our terms are reasonable and our booklet giving full information on patents will be sent on request.

J. L. JACKSON & CO.

212 Ouray Building - Washington, D. C.

WRITE A SONG

You can do it. Write about Love, Mother, Home, Childhood, Comic, Patriotic, or any subject and **send words to me at once.** I compose music and guarantee publication.

EDWARD TRENT, 631 Reaper Block, CHICAGO

WIRE

electrical, rope, airplane, piano, pipe-organ, flat, hoops, bale-ties, tacks, nails, barbed-wire, concrete re-inforcement, springs, netting, wire fences, steel posts, trolley-road wires, and rail bonds, wire wheels, auto-towing cables, horse-shoes.

Illustrated Books Describing Uses, FREE

American Steel & Wire Co. F. Baackes, V. P. and G. S. A. CHICAGO

The Midget Slide Rule

will instantly add, subtract, multiply and divide either whole numbers, decimals, fractions or mixed numbers. It solves proportion and gives roots, powers, Sines, Tangents and Logs. The most versatile calculator ever invented. Made of Metal. Size 4". Price with Instruction Book, $1.50. Satisfaction guaranteed. Send for our Catalogue and Instructions in Logarithms and Trigonometry.

Gilson Slide Rule Co.
Niles, Mich.

Charge Batteries—Make Your Own Light

The HB Lighting and Battery Charging Set makes electric lights for as low as 2c per KW. and at the same time brings profits of $100 to $150 per month charging batteries. Operates from line-shaft or engine.

Small Payment Puts This Money-Maker in Your Garage or Shop

Balance on easy terms. Profits pay for outfit. Absolute Money-Back Guarantee. Ask our Service Department about proper size for your needs. Pin this ad to your letterhead and write TODAY for information.

Hobart Brothers Company, Box S-16, Troy, Ohio

Dancing Made Easy

In a few hours at home you can easily become an accomplished dancer by my amazing new chart system. Simple as counting. Learn Waltz, One-Step, Two-Step, Fox-Trot and all late dance steps. Be popular—the envy of the crowd. Thousands have learned this way.

Free Simply send name—a card will do—for book that tells about my marvelous new system. Special low rates now. Write me today. Prof. H. E. Wolfe, President.

WOLFE'S MODERN DANCE STUDIOS
108-D Wolfe Building, Kansas City, Missouri.

Keep Young Thru Pandiculation

You feel the need of exercise. You haven't time. 15 minutes use of Pandiculator equals 2 hours in gymnasium. Gives you punch, pep, and vigor. The lazy man's gym. 32-p. booklet FREE.
The Pandiculator Co., 343 Advance Bldg., Cleveland O

Home-Made Toys for Girls and Boys

Here is a veritable gold mine of suggestions for home-made toys, each one of which has been carried out successfully many times..... **Price $2.25**
Popular Science Monthly 225 West 39th Street, New York

Gibson Instruments

Mandolin, Mandola, Mando-Cello, Guitar, Tenor-Banjo, Mandolin-Banjo, Cello-Banjo, Guitar-Banjo, Harp-Guitar, Mando-Bass —

Easy to Play
Easy to Pay

Select your **Gibson** now. You can soon be playing the music of the day. Your friends will be surprised and delightfully entertained. Let us help you organize a **Gibson** Orchestra in your community. You can increase your popularity, income and pleasure by playing for Concerts, Entertainments, Church Affairs, etc. A small down payment and then $5 a month will soon pay for a **Gibson** and will furnish you with wholesome, year-'round entertainment. If you have an old instrument, we will make liberal allowance on a **Gibson.** Write Today for Free Book, Catalog, Free Trial Offer, information about Wm. Place, Jr. Book and the instrument you prefer.

GIBSON MANDOLIN-GUITAR CO.
481 Parsons St., Kalamazoo, Mich., U. S. A.

$100 WEEK AND MORE FOR YOU!

TIRE SURGERY—the NEW and BETTER tire repair method is making men RICH! Chas. Evans, carpenter, past 50, now MAKING $100.00 a week in shop shown here. Gibbard of Mich., age 62, learned TIRE SURGERY, has shop in small town, writes: "Cash receipts for May, June and July, 1920, $30,000.00."

HAYWOOD'S TIRE SURGERY

is easy to learn. I will teach you in two weeks. Within thirty days you're started on road to fortune. Car owners EVERYWHERE demand this NEW repair method, as it DOUBLES life of Tires. 28 million tires wearing down DAILY. ONE THOUSAND MORE Tire Surgery shops needed badly. ANY MAN can succeed QUICKLY. It's a SHORT, EASY step into automobile industry—the field that has made men rich. It put $6,000.00 in bank for John W. Blair, Ohio, in 12 months; got $3,000.00 for Fleming, of New Zealand, within 1 year; and has done same for hundreds of others. There's money in this business for YOU. Investigate! Get details. Send coupon at once for the FREE book.

WRITE

Mr. Haywood, Pres., Haywood Tire & Equipment Co.
1275 Capitol Ave., Indianapolis, Ind.
Dear Sir: Send full details of Tire Surgery, as I want to get into big paying business quickly.

Name_____

Address_____

Get Into This New Big Pay Field *Now!*

Trained Traffic Experts Earn $2500 to $10,000 a Year and More

Do you want to get into a field of work that is uncrowded—where the job will seek you instead of you looking for it? Do you want to earn $2,500 to $10,000 or more a year? Do you want a position of prestige and independence? Do you want to be one of the biggest—one of the most important men of your company? Of course you do! Then train for traffic work—be a traffic expert.

Transportation today is the country's second largest industry. Four billions of dollars are annually spent in freight charges. Yet perhaps eight of every ten shippers are losing money. And why? Just this: few of the men now in traffic work actually *know* how to route, classify and pack freight to get the cheapest rates. Millions of dollars are being wasted in this way. 100,000 more competent, well-trained traffic men are needed to stop these losses. Be one of these experts and you won't have to look for a job. The job will look for you. You may almost set your own salary!

Thousands of Jobs Open—Train for One in Spare Time

Right now opportunities are unlimited. The great boom in both foreign and domestic trade are crowding the railroads and the Merchant Marine to their carrying capacity. Thousands of men trained in traffic work, are wanted to direct this great flow of trade. Railroads, shippers, and shipowners are literally begging for men. You don't have to quit your job to qualify for one of these splendid positions. Just as we have already trained thousands of others so can we train you—right in your own home, in your spare time. Traffic men of national reputation, the recognized leaders of the field, will tell you all the secrets of Interstate Commerce. The training is thorough, yet easy and interesting. The cost is but a few cents a day. Get in now! A splendid future and a quick success at a big pay job awaits you!

Write for FREE Book

Let us send you "Opportunities and Requirements for Traffic Work." It is a remarkable book that explains in detail this great system of training. It shows how men must be trained in traffic work. It tells all about this wonderful organization of expert traffic men who include such men as T. A. Gantt, Traffic Manager, Corn Products Refining Company; Ralph H. Drake, Division Freight Agent, American Can Co.; Samuel G. Lutz, Vice-President, Chicago & Alton Railroad, and nearly 200 others of equal prominence. They have banded together to correct the big mistakes made daily in shipping freight, that are wasting millions of dollars every year. They are giving their time to train men to right this condition. You will learn how the A. C. A. Advisory Traffic Council renders an indispensable service to the successful traffic men. Get this great, new free book now. It will open your eyes to the splendid opportunities in this fascinating new profession. Mail the coupon, or send a letter now to the

American Commerce Association
Dept. 141, 4043 Drexel Blvd.
Chicago, Illinois

AMERICAN COMMERCE ASSOCIATION,
Dept. 141, 4043 Drexel Boulevard,
Chicago, Illinois.

Please send me, without obligation on my part, your free book, "Opportunities and Requirements for Traffic Work." Also tell me how I can qualify as a traffic expert.

Name.....

Address.....

Age.....Occupation.....

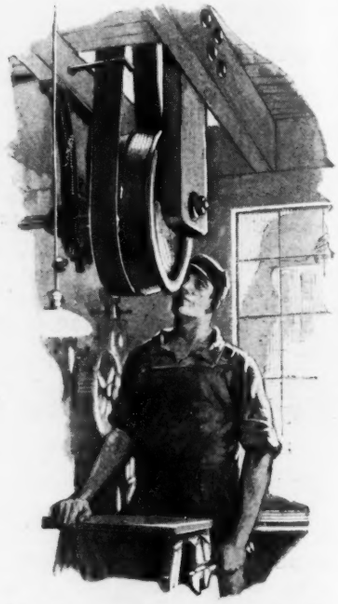
The Neatest Mechanical Job I Ever Saw

Selecting the prize-winners in the contest was a difficult task

WHEN the Popular Science Monthly in the early part of the year, offered three prizes, aggregating $90, for the neatest mechanical jobs that had ever come under the observation of the contestants, as described by them and illustrated by photographs or drawings, it was not expected by the editors that the selection of the prize-winners would present great difficulty. But, when replies began to come in from all parts of the world and the material offered was looked over and sifted, it became clear that the final selection would be extremely difficult in view of the large number of meritorious answers.

Truing up a defective shaft by means of an emergency jig carrying a cutter, earned for J. Edgar Mitchell, of Huntsville, Alabama, the first prize of $50

After carefully weighing the relative value of each point of merit, the first prize of $50 was awarded to J. Edgar Mitchell, of Huntsville, Alabama. He described the neat and efficient method employed by him and another machinist in truing up the shaft by which the 150 horsepower engine in the local power plant was directly connected with the generator. The engine developed a knock, and upon investigation its cause was located in the center main bearing. It was found that the shaft was 3/32 in. out of true cylindrical form. Removing the shaft for the purpose of truing it would have consumed too much time. The prize-winner and another machinist solved the problem by rigging up the jig shown in the illustration from pieces of flat iron, pipe spacers, and a steel screw with flat iron bearings. A cutting-tool was clamped in the jig and while the engine was run slowly the shaft was made true. The entire work was done in one day and a half.



John Premru, of South Norwalk, Connecticut, earned the third prize of $15 by the neat method of providing a loose pulley for disconnecting a machine

The second prize of $25 was awarded to Myron Drachman, of New York, for the clever use of a gas-pipe and a speaking-tube in constructing a call-bell circuit

The second prize of $25 was awarded to Myron Drachman, of 128 West 121st street, New York, for the neat and clever manner in which he established an electric call-bell circuit between the basement and the fourth floor of a house. Having ascertained that there was no short circuit between the gas-pipe and the speaking-tube, both of which extended from the basement to the fourth floor, he used the gas-pipe in place of one wire, the speaking-tube in place of the other, connected the bell with the two lines on the fourth floor, and battery and push-button with the other ends of the two

lines in the basement, establishing a complete circuit without tearing up the house or spending money for wires.

The third prize of $15 was awarded to John Premru, of South Norwalk, Connecticut, who described how he had rigged up a loose pulley to make it possible to disconnect a working machine without stopping the engine. Parallel with the driving pulley and at a distance of ⅛ in. he placed a wooden, home-made pulley of the same diameter, but slightly bevelled and provided with a flange. This pulley runs loosely on a pin or bolt fastened to an improvised wooden hanger bolted to one of the beams of the ceiling. A belt-shifter made it possible to change the belt from the driving pulley to the loose pulley and back again as desired.

Among the entries to the contest which were not awarded a prize are several of great merit and these will be published in the Popular Science Monthly as space permits.

To Make a Combination Sled and Toboggan

THE boy with the sled is jealous of the boy with a toboggan and the one owning a toboggan is apt to feel jealous of the boy with a sled. This

Your boy will be happy if you make this combination sled for him

combination sled and toboggan is designed to furnish the two in one.

One side is planked over with a solid, smooth bottom, while the opposite side, that is, when the contrivance is turned over, is furnished with round iron runners like a sled.

Procure two planks 5 ft. long by 12 in. wide and 1 in. thick. Taper each one so one end will measure 12 in. wide and the opposite end will measure 9 in. Round the 12-in. end in the form of a semicircle. The narrower end should then be notched as shown. Smooth the notch out round so it will resemble the back end of a sled-runner, no matter which side the planks are set on.

Get your local blacksmith to make you a pair of half-round iron runners similar to sled runners. Drill these with several holes along their length and countersink them on the round

"I'm A Man- I Want Man's Pay!"

That is what Albert Foster wrote us eighteen months ago, and he goes on: "I'm tired of being bossed for $25 a week. I want a He-Man job with real pay. I want to get into the $100 a week class. Tell me how to do it." We showed him how. Today he has a He-Man job and He-Man pay. We tell of his experience because it's typical.

WHAT ARE YOU? A man who is up and doing, getting real money, or are you simply marking time on $25 or $30 a week? $100 jobs don't go begging. If you want one you've got to go after it. Are you satisfied with your present condition in life? If you are, we have nothing to offer you, but if you want one of these real jobs with big pay, then we can help you and help you in a hurry.

A REAL MAN with a real man's pay is what you want to be, and we will show you how. Without loss to you of a single working hour, we will show you a sure way to success and big pay. A large number of men in each of the positions listed are enjoying their salaries because of our help —we want to help you.

Make a check on the coupon against the job you want and we will help you get it. Write or print your name on the coupon and send it in today. You will be under no obligation.

American School of Correspondence
Dept. G-175 Chicago, U. S. A.

AMERICAN SCHOOL of CORRESPONDENCE

Dept. G-175 Chicago, Ill.
Explain how I can qualify for position checked:

___Architect $5,000 to $15,000	___Accountant and Auditor $2,500 to $7,000	___Steam Engineer $2,000 to $4,000
___Building Contractor $5,000 to $10,000	___Draftsman and Designer $2,500 to $4,000	___Foreman $2,000 to $4,000
___Automobile Engineer $4,000 to $10,000	___Electrical Engineer $4,000 to $10,000	___Photoplay Writer $2,000 to $10,000
___Automobile Repairman $2,500 to $4,000	___General Education In one year	___Sanitary Engineer $2,000 to $5,000
___Civil Engineer $5,000 to $15,000	___Lawyer $5,000 to $15,000	___Telephone Engineer $2,500 to $5,000
___Structural Engineer $4,000 to $10,000	___Mechanical Engineer $1,000 to $10,000	___Telegraph Engineer $2,500 to $5,000
___Business Manager $5,000 to $15,000	___Shop Superintendent $3,000 to $7,000	___High School Graduate In two years
___Certified Public Accountant $7,000 to $15,000	___Employment Manager $4,000 to $10,000	___Fire Insurance Expert $3,000 to $10,000

Name _____

Address _____

John Dolan, solo cornetist, Sousa's band, thrills thousands nightly with his Conn. He says: "The CONN cornet possesses a rich tone, perfect scale and IS EASY TO PLAY IN ALL REGISTERS, PARTICULARLY THE UPPER."

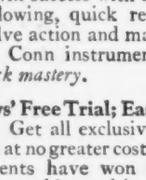
How to Master the Cornet Quickly

THINK of the fascination, the opportunities for you to play in band or orchestra; travel; increase your income! Cultivate your musical "bump." Take a tip from artists like Dolan and Lewis; win success with a Conn. Easy blowing, quick response, light valve action and matchless tone in Conn instruments *give you quick mastery.*

Six Days' Free Trial; Easy Payments. Get all exclusive Conn features at no greater cost. Conn instruments have won highest honors at world expositions. Send coupon for details.

A Guarantee Bond with Every Conn

C. G. CONN Ltd
132 Conn Bldg. Elkhart Ind.
Agencies in all large cities
WORLD'S LARGEST MANUFACTURERS OF HIGH GRADE BAND AND ORCHESTRA INSTRUMENTS



Ted Lewis, saxophone comedian and director of Lewis' famous Jazz Band uses the CONN and praises its key mechanism, tuning device and other exclusive features which make the Saxophone EASIER TO PLAY.

FREE BOOK
Full of musical information, describes all instruments, helps you decide which *you* want to play. No obligation; send coupon for your copy.

C. G. CONN, Ltd.
132 Conn Bldg., Elkhart, Ind.
GENTLEMEN:—Please send me your free book and details of free trial offer of any instrument.

Name.....
Street or R. R......
City or State.....
Instrument.....

side. Make them long enough so the ends can be bent over and fastened to the ends of the planks as shown. Fasten one to the corresponding edges of each plank with long screws, countersinking them well so they will not interfere with the smooth passage over the snow.

Then place several ribs between the two planks to fasten them together. These ribs are square sticks, 2 ft. long. Place them close to the edges of the planks opposite the runners and be sure there are at least three of them near together at the front or curved end. At this end the highest rib should not come higher than halfway up the curve.

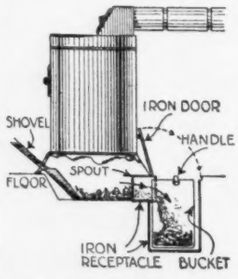
With these in place, plank them over with ½-in. soft pine or cedar planking. Fasten these planks to the ribs and edges of the side planks with countersunk screws. To bend the planks up over the curve formed by the ribs it may be necessary to soak them in hot water to make them pliable. This forms the toboggan bottom. Fill with oil and sandpaper smooth.

Lastly, nail several light slats lengthwise across the inside surface of the ribs to act as a floor for the toboggan passengers.

In this position the passengers can use the contrivance as a toboggan on soft snow. Then by turning it over, it can be used as a sled on hard snow and the passengers can sit on the toboggan bottom. Bore two holes in the front of the sides for attaching the pull-rope.—L. B. ROBBINS.

A Dustless Ash Receptacle for the Furnace

ONE of the most disagreeable features of hot-air furnaces is the dust which arises in clouds and pervades the whole cellar whenever the accumulated ashes are removed from the ash-box under the grate. A built-in ash-pit under the furnace with a suitable outlet to the yard would remove this feature, but such pits are rarely provided except in private residences built to order.



The ashes are raked in the covered bin and no dust arises

The ash receptacle shown in the accompanying illustration and patented by its inventor may be installed in connection with almost any type of hot air or steam-heating furnaces and will greatly abate the dust evil.

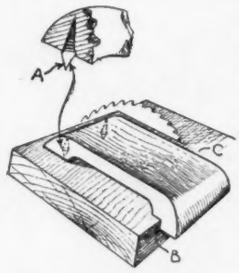
The only structural changes necessary for the installation of this dust-proof receptacle for ashes are a small and shallow pit in the rear of the furnace, large enough to accommodate the ash-bin, and the cutting of an opening through the rear wall of the furnace, slightly below the level of the floor of the ash-box. The chute connecting the rear of the ash-box with the bin is fitted in this opening, and into the flanged spout of the bin.

The ashes, instead of being shoveled out through the door of the ash-box, are pushed back and slide through the chute into the covered bin in the rear of the furnace, where they are caught in a bucket loosely fitting the bin. This bucket, which holds as much as two average coal-scuttles, can be lifted out of the bin by a handle.

Save the Fingers from Injury in Sawing

SAWING wood with a circular saw is a dangerous task unless proper care is taken.

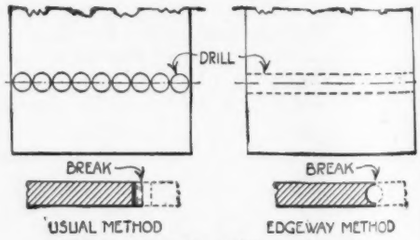
By using a wooden finger-guard as shown in the accompanying illustration, much of the danger is eliminated. *A* represents two small wooden screws with their heads cut off. The threaded portion is screwed into the guard, and the other part is filed to a sharp point. These two points grip the wood firmly and allow you to put a good pressure on the saw without danger of slipping. *B* is a wooden hand-rest which engages the rear edge of the board that is to be sawed.



"Safety first" suggests this finger-guard for saws

Cutting Steel Plates by Drilling Edgeways

THE usual method of cutting cast-iron or steel plates by drilling is to make a series of holes almost running into each other, then breaking it, leaving an extremely jagged edge to be finished off.



Cutting plates by drilling edgeways makes a much neater job

An old-time mechanic was observed following a different method of procedure in cutting some cast-iron plates about ¾ in. thick. They were clamped in a vise on a drill-press table and holes drilled down edgeways, two holes from the opposite sides of each plate meeting about the center, the drill being 23/32, thus leaving little to be broken away.

Two Great Books on Alternating Currents

I
Experiments
with 110-Volt Alternating Currents

This really wonderful book by J. D. Adams explains what can be done by the amateur electrician with the 110-volt commercial circuit. It shows how the 110-volt commercial circuit may be handled with perfect safety and without involving the expense necessary to maintain a power supply.

It is written so clearly that everyone can understand it. There are profuse illustrations and diagrams which show exactly how you can make these experiments yourself.

The only way to gain a thorough understanding of electricity, as it is used commercially, is by direct personal experiment. The knowledge thus gained is of vastly more value and importance than that acquired from the performance of the stereotyped series of battery experiments so uniformly described in the text books. The many experiments described in this book were all performed at home and not in a machine shop or laboratory. The apparatus involved was necessarily made as simple as possible consistent with the securing of striking results.

Fully Illustrated. Price Postpaid, $1.75

II
Construction
of Small Alternating Current Motors

By PROF. A. E. WATSON
Brown University

This book contains complete instructions for building small alternating current motors in several sizes. The designs will be found in harmony with those of the very best manufacturers and they can be worked out by the amateur for making useful instruments.

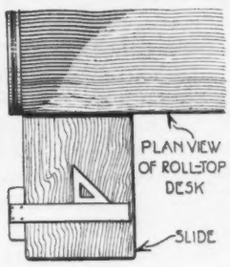
Some of the subjects taken up are "Characteristic Features of Alternating Current Motors," "Construction of a One-Half Horsepower, Single Phase Induction Motor," "Procedure in Testing and Using an Alternating Current Generator or Synchronous Motor." Clear, concise directions and careful drawings are features of this book.

Fully Illustrated. Price, $1.50

Popular Science Monthly
225 West 39th Street, New York

The Roll-Top Desk Used as a Drawing-Board

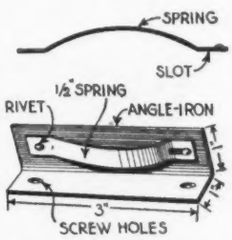
HOW often have you, when at work on a roll-top desk, wished for a small drawing-board for making plans? One day, quite by accident, I thought of the plan shown in the illustration. Why not pull out the slide and make a small T-square to fit it? No sooner thought than done, with the result that the little T-square, with a small 4-in. triangle, made an ideal sketching outfit, at hand at all times. An improvised drawing-board like this is particularly convenient for draftsmen who wish to work at home, but have not room enough for a drafting-table.—J. W. MOORE.



The slide of a roll-top desk will make an excellent drawing-board

Eliminating Rattles from Automobile Doors

AN automobile which has run a year or so usually develops an annoying door rattle. This is because the body has become worn and gives with every jolt from the running gear. Use a piece of 1-in. L-iron 3 in. long, with holes drilled as shown, and rivet on a piece of ½-in. clock spring. If the steel is too hard, heat it and bend it, cooling it quickly to restore its temper. Countersink the wood screw holes and file down all edges smoothly.



This little device prevents your automobile doors from rattling

Screw this device to the body so that when the doors are closed the springs are about flat and, of course, under tension. As the door is closed the spring receives the impact gently and keeps it tight.—P. P. AVERY.

A Hot Garage Will Injure Your Car

WHILE it is, of course, most advantageous to heat the garage by some means or other during the cold months, there is another extreme that should be avoided. We refer to keeping the garage too warm. If the heat is too intense, the sudden change of temperature when the vehicle is taken out into the cold air, or when it enters the overheated garage after having been in the cold, is apt to cause the varnished panels to check and fine cracks to appear in the finely finished varnish coating of the body.

New Invention Shows
How to Write and Speak Masterly English

LET us send you, absolutely free, a copy of our new illustrated book, "How to Write and Speak Masterly English." You will be glad you wrote for this book, no matter how much or how little you may know about the English language and its proper usage in your business and social life. This book, sent free, is for the employe and employer, for stenographers, bookkeepers, authors, correspondents, clerks, credit men, typists, lawyers—in fact for everyone who really wants to make a *habit* of using correct English. Write today for this book.

New Invention
Takes Only 15 Minutes a Day

Yes — only 15 minutes a day with Sherwin Cody's New Invention — and you can actually SEE how your English improves. The mechanical drudgery is eliminated. No rules to memorize. Mr. Cody is perhaps the greatest and best known teacher of business English in the country. This new patent is the result of 20 years' experience and takes the place of a teacher at your elbow. Whatever work you do your English "makes or breaks" you. Incorrect spelling, punctuation, pronunciation or usage, or the use of flat, ordinary words handicaps you in business and among your friends. You can improve your English now in 15 minutes a day, in spare time. Make words WIN for you.

Sherwin Cody's New 100% Self Correcting Method

The average person in business or at school is only 61% efficient in English. Mr. Cody's method teaches you from the ground up. Old methods do not stick in the mind. Mr. Cody's new invention teaches by HABIT—makes it EASIEST to do it in the RIGHT way. Lessons include Letter Writing, Spelling, Punctuation, Grammar, Reading and Conversation. One lesson each evening except Saturday and Sunday. Only 15 minutes a day. And so simple is the new Invention that you see at a glance your errors and note every day your improvement.

FREE! Every time you speak or write you show just how much you know. Lack of language power may easily be costing you thousands of dollars every year. See what Mr. Cody can do for you. See what a few minutes a day NOW will mean to you later. It costs nothing to find out. Mail the coupon or a postal card this very minute for the free book "How to Speak and Write Masterly English." It will prove a revelation to you. WRITE NOW. Address

Sherwin Cody School of English
181 Searle Bldg. ROCHESTER, N. Y.

SHERWIN CODY SCHOOL OF ENGLISH
181 Searle Bldg., Rochester, N. Y.

Please send me your Free Book, "How to Write and Speak Masterly English."

Name _____

Address _____

Learn to Fill BIGGER Shoes!

NO matter what kind of work you are doing now, a set of these great home study books will quickly fit you for a bigger and better paying job. We will send any set you select for one week's free examination, and if you want to keep them you pay only the special reduced price, at the rate of 75 cents a week. This is your opportunity to make more money—grasp it NOW. Use these books and a little spare time and LEARN TO FILL BIGGER SHOES.

Pay-Raising Books at Greatly Reduced Prices

Accountancy and Business Management, 7 vols., 2700 pages, 1000 pictures. Was $52.50. Now **$29.80**

Carpentry and Contracting, 5 volumes, 2138 pages, 1000 pictures. Was $37.50.....Now **24.80**

Civil Engineering, 9 volumes. 3900 pages, 3000 pictures. Was $67.50.....Now **39.80**

Electrical Engineering, 8 volumes, 4100 pages, 3300 pictures. Was $60.00.....Now **34.80**

Automobile Engineering, 6 volumes, 2600 pages, 2000 pictures. Was $45.00.....Now **29.80**

Machine Shop Practice, 6 volumes, 2300 pages, 2500 pictures. Was $45.00.....Now **29.80**

Steam and Gas Engineering, 7 volumes, 3300 pages, 2500 pictures. Was $52.50.....Now **29.80**

Law and Practice, (with reading course), 13 volumes, 6000 pages, illustrated. Was $97.50. Now **49.80**

Fire Prevention and Insurance, 4 volumes, 1500 pages, 600 pictures. Was $30.00.....Now **19.80**

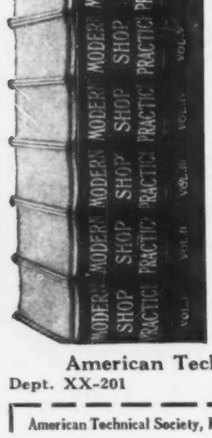
Telephony and Telegraphy, 4 volumes, 1728 pages, 2000 pictures. Was $30.00.....Now **19.80**

Sanitation, Heating and Ventilating, 4 vol., 1454 pages, 1400 pictures. Was $30.00....Now **18.80**

Drawing, 4 volumes, 1578 pages, 1000 pictures, blue-prints, etc. Was $30.00.....Now **19.80**

Send No Money
Shipped for 7 Days' Trial

Write the name of the books you want on the coupon and mail it today. We will send the books at once, express collect, and you can use them just as if they were your own for a whole week. If you decide you don't want to keep them, send them back at our expense.



75c a Week

If you like the books, as thousands of other men have after examination, just send us $2.80. You can send the balance of the special reduced price the same way—$3.00 each month (75 cents a week).

Start right now and learn to fill bigger shoes. There will be a better job looking for you if you do. Be ready to meet it when it comes. *Send the coupon now.*

American Technical Society
Dept. XX-201 **Chicago**

American Technical Society, Dept. XX-201, Chicago, U.S.A.

Please send me set of .....

.....

for 7 DAYS' examination, shipping charges collect. I will examine the books thoroughly and, if satisfied, will send $2.80 within 7 days and $3 each month until I have paid the special price of $..... If I decide not to keep the books I will return them at your expense at the end of one week. Title not to pass to me until the set is fully paid for.

Name.....

Address.....

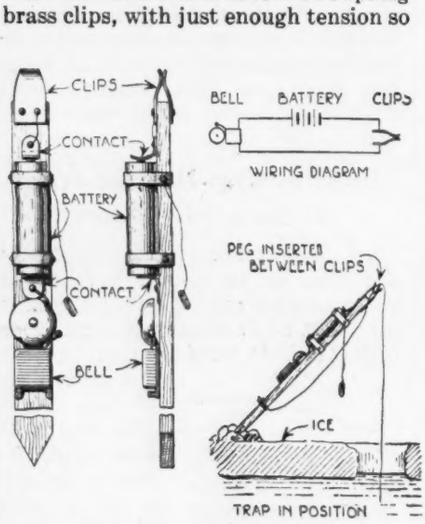
Reference .....

An Electric-Alarm Trap for Ice Fishing

THE glare of an icy lake becomes very tiresome to one watching the red flags of fish-traps on a sunny day. To relieve this condition, the trap herein described departs from the visual signal and gives warning of a hooked fish by an electric bell. It is just as simple to make as the "tip-ups," and will give an unfailing alarm. It is a good plan to fit each stick with a bell of a different tone and to place them at widely scattered points about the lake. Their tones can be soon distinguished and the fish pulled in.

The stick is a piece of straight grained wood, 24 in. long, 2 in. wide, and ½ in. thick. Point one end so that it can be inserted easily in a hole chopped in the ice.

At the other end screw two spring brass clips, with just enough tension so they will give a firm contact, but not so tight that they cannot be easily forced apart.



If you use one of these traps, you may safely take a nap between bites

About midway down the stick mount an old flash-lamp tube with both ends removed. Set the cells in the tube and screw a small contact of brass to the stick at each end of the tube so they will hold the cells firmly in place. Fasten the tube to the stick by two bands of tin.

A small electric bell should then be mounted on the stick directly below the battery. The wiring diagram is shown in the detail illustration.

Tie a small piece of sheet rubber or fiber to a string and suspend it from the side of the stick. This is placed between the battery and contact at *A* when it is desired to break the circuit.

Paint all the wiring, battery tube, and other exposed parts requiring it, with two coats of shellac.

Tie the fishing-line to be used to the lower part of the stick and provide a small piece of hard wood, shaped like a sinker, which can be slipped along the line to determine the distance the line will hang from the clips.

Set the stick in a small hole in the ice alongside the fishing-hole. Water and ice chips around the stick will freeze and hold it solid.

Place the wooden peg at the proper point on the line and place it between the clips. Remove the fiber contact-breaker from the battery and let it hang.

When the fish takes the bait and runs with it, it will pull the peg from between the clips. This completes the electric circuit and rings the bell.

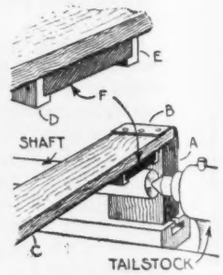
The fisherman pulls in the fish, rebaits his hook, and resets the alarm, removing the contact-breaker before leaving.—WINDSOR CROWELL.

Filing Shafting in the Lathe Becomes Easy

SHAFT-FILING can be accomplished in more ways than one. The usual hand method is tiresome, to say the least.

Having a number of shafts to file we rigged up the device shown in the illustration.

We placed a block, *A*, at the rear end of carriage, and a board, *C*, in the position shown. Then we connected both with a leather hinge, as illustrated at *B*.



Filing shafting made less tedious by this improvised jig

Under the board *C* we placed two small pieces, *D* and *E* (see enlarged view), and into this we slipped a piece of a file.

The rest is self-apparent. We merely pressed on the end of the board *C*, put in the carriage feed, and the file traveled along the work.

A Florence Flask Made from an Electric Lamp

MANY of the incandescent lamps now being manufactured are of the "tipless" variety; that is, they are free from the sharp point on the glass which was necessary in exhausting the air from the globe.

Economical chemists make Florence flasks from burnt-out lamps.

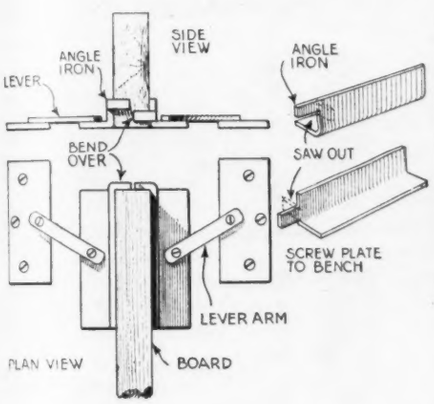
Such lamps can be made use of, after the filament is burned out, to form round-bottom flasks for use in the laboratory.

It is the work of only a few seconds to file a scratch around the glass near the small end, and to break off the globe at this line. The edges are readily rounded off by holding in a flame.

An Efficient Bench-Stop for Boards

A BENCH-STOP, for holding boards to be planed on the edges, which can be easily made and which does the work better than the kind usually employed, is shown in the illustration. In operation, the board is pushed against the bent ends of the angle-irons. This causes the levers to swing and the angle-irons to close tightly on the board. The bench-stop holds tighter as the cutting pressure becomes greater.

Two pieces of angle-iron of any convenient size are provided—1-in. angle-iron, about 4 in. long, will answer perfectly for all general purposes. One of these irons is cut out on one end for a distance of about 1 in., and from the center down. The other is cut in the same way, but from the center up. The overhanging sections are then bent over toward the flat side, so that the



Guided by these drawings and the text, the amateur carpenter will be able to make a bench-stop like this

pieces viewed from the end will appear as shown in the end view. This permits the flat sides of the two pieces to be brought together without the bent ends touching each other. The plates screwed on the bench should be about 1 in. by 4 in. by ¼ in. The angle-irons are fastened to these plates by levers so that they are free to swing. The levers should be about ¼ in. by ¾ in. A length of 2½ in. will give the stop about a 4-in. opening.

This stop holds the work firmly, and even when planing the opposite ends of long boards, the ends cannot swing around as sometimes happens with the usual type of bench-stop.—R. H. KASPER.

Most Paints Are Improved by Zinc Oxide

PAINT in which suitable proportions of zinc oxide are used covers more surface than lead alone, according to leading paint technologists. Zinc oxide also imparts toughness to the film, reduces chalking, gives the coating improved luster, preserves the oil, and lessens the danger of fading.

$3,600 Draftsman's Salary =

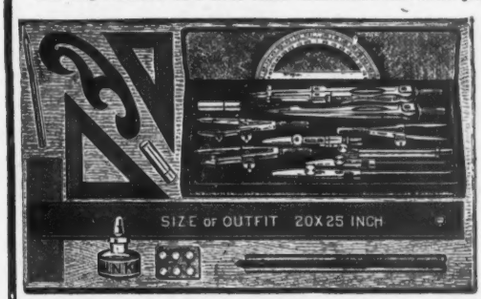
FREE Drafting Tools =

Trained Until You Get Job

That's My Offer— Chief Draftsman Dobe

STUPENDOUS! That's the word for this greatest—most magnificent Drafting offer! I know how far my offer leads all others. I guarantee every word and my hundreds of students and graduates know Dobe backs up all his promises. First about that $3,600 salary. I train you *personally*. I make you qualified to draw $3,600 per year like scores of my other graduates are doing. I give you practical drafting room work. Everything just exactly as you would get it in a real job. I give you my personal man-to-man attention.

And I train you *until* (now get the full meaning of this) *un.* you are qualified and experienced as a first class draftsman and *until* placed in a permanent position drawing a first lass draftsman's salary.



FREE $25.00 Outfit

And *more*—I give you a whole set of drafting tools the minute you become my student. You get every tool you need. A magnificent $25.00 set of instruments with which to build your success in draftsmanship.

Remember—the draftsman goes up and up to the fabulous incomes of engineers and architects.

Send Coupon for Free Book

No matter what plans you have for the future. Get this great book—"Successful Draftsmanship". Find out about the simply marvelous opportunities ahead now. How the world needs draftsmen; engineers; architects and builders. What great salaries and possibilities there are! Send coupon for my free book today.

Chief Draftsman Dobe
Dept. 1361, 4001 Broadway, Chicago, Ill.

Chief Draftsman Dobe
Dept. 1361, 4001 Broadway, Chicago

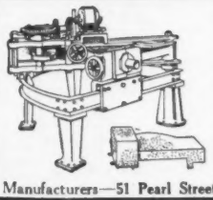
Without any obligation whatsoever, please mail your book, "Successful Draftsmanship", and full particulars of your liberal "Personal Instruction" offer to few students.

Name.... .....

Address.....

Post Office.....*State*.....

How to Become a Successful Electrician
By PROF. T. O'CONOR SLOANE. The studies to be followed, methods of work, field of operation and the requirements of the successful electrician are pointed out and fully explained 202 pages. Illustrated..... Price, $1.50
Popular Science Monthly - 225 West 39th Street, New York.



Power Benders
THREE NEW MODELS
"COLD" Pipe Bending Machines (pat.) electrically operated to bend from 1 inch to 8 inches. Send for printed matter. We also manufacture TEN other sizes, hand operated to bend from 1-8 to 6 inches.
American Pipe Bending Machine Co.
Manufacturers—51 Pearl Street, BOSTON, Mass., U. S. A.

BIG MONEY
Selling Eagle Sawing Machines
Every timber owner needs one. Powerful, fast-cutting, saws the natural way. A demonstration sells it. Representatives making from $80 to $300 a week. You can make $2.00 An Hour sawing wood while demonstrating. Write today for full information and Special Low Agent's Prices.
Eagle Sawing Machine Co
Dept. 482, Kansas City, Mo.

ADDITIONAL MACHINE SHOP AND FOUNDRY FACILITIES AVAILABLE
Large manufacturing plant in Cleveland, well organized and equipped for Machine Shop, Pattern Shop and Foundry production, will consider converting part of its production capacity to some manufacturer upon a low cost production basis. This is an ideal opportunity for manufacturer wishing Cleveland factory connection with a well organized plant. Address replies in care of
THE NESBITT SERVICE COMPANY
Caxton Building, Cleveland, O.

LUFKIN TAPES AND RULES
INSURE YOUR MEASUREMENTS
Stocked by Dealers—Send to us for Catalog No. 12
THE LUFKIN RULE CO. SAGINAW MICH.

MONARCH LATHES

In the largest factories in the smallest machine shops—wherever lathes are used—Monarch Lathes are found.

Built right of the very best material—designed to meet all conditions in lathe work—Monarch Lathes deliver perfect work of the most minute accuracy and give long time service.

Moderately priced because they are built in quantity. Guaranteed to give satisfaction to the purchaser.

Write today for catalog and full information of Monarch Lathes.

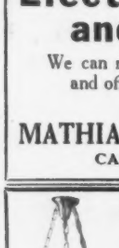
The Monarch Machine Tool Co.
108 Oak Street
Sidney, Ohio

Electricians' Knife and Tweezers

We can meet dealers' demands at once and offer attractive quantity prices

Write for description

MATHIAS KLEIN & SONS, Mfrs.
CANAL STA. 3, CHICAGO



"Lighting Fixtures"

Ready to hang.
Direct from manufacturers.
Completely wired including glassware.

Send for Catalogue No. 20

ERIE FIXTURE SUPPLY CO.
Desk A, Erie, Pa.

Self-Taught Mechanical Drawing and Elementary Machine Design

By F. L. SYLVESTER, M. E. A practical elementary treatise comprising the first principles of geometric and mechanical drawing, workshop mathematics, mechanics, strength of materials and the calculation and design of machine details. 330 pages, 215 engravings..... Price, $2.50

Popular Science Monthly - 225 West 39th Street, New York

Fighting Snowdrifts with an Automobile Plow

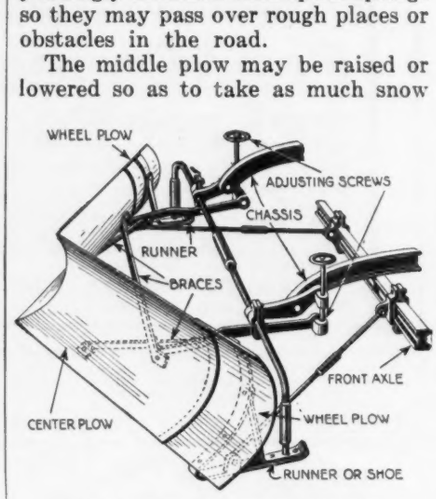
IF you live in the country or in the suburbs and do not wish to be marooned by every snowstorm, get a snowplow like that shown in the accompanying illustrations, provided, of course, that you are the fortunate possessor of an automobile of some

With this snowplow attached to their car suburbanites need not fear a snow blockade

kind to which you can attach the plow. The drawing clearly explains the construction of the plow, which is the invention of Claude C. Hyde, of Otisville, New York.

The plow consists of two side parts, placed directly in front of the front wheels, and a V-shaped middle part. The wheel plows are supplied with shoes or runners, which keep it from digging into the roadbed and are yieldingly attached with spiral springs so they may pass over rough places or obstacles in the road.

The middle plow may be raised or lowered so as to take as much snow



The plow attachment can be easily disconnected when it is not needed

from the road between the wheels as the power of the automobile engine will permit. When the plow is not needed, it may be removed in a few minutes and without the use of special tools.

One Way of Removing Dents in Wood

UNSIGHTLY dents in woodwork of almost every description can be removed easily by the following simple method:

First thoroughly sponge the dented part with warm water, allowing it to soak well into the wood. Then take a piece of brown wrapping-paper, fold it into half a dozen thicknesses, and, after soaking well in warm water, lay it over the dent previously sponged.

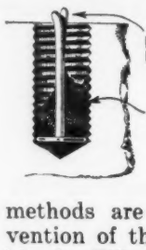
The treatment is completed by applying a hot flatiron until all the moisture is evaporated.

For dents of ordinary depth, one application is usually sufficient to raise the dent level with the surface, and the worst cases will yield to this treatment if repeated two or three times.—GEORGE H. HOLDEN.

Methods of Keeping Carbon Out of Bolt-Holes

WHEN cleaning carbon out of an engine with the cylinder head off, carbon will get down into the bolt-holes holding the head unless some precaution is taken to keep it out. Carbon in bolt-holes means a loss of time, especially after the gasket and head are assembled. Two simple

Filling the bolt-holes with water will prevent them from becoming filled with carbon



Another way to keep bolt-holes free from carbon consists of inserting long paper-fasteners

methods are suggested for the prevention of this or they may be combined. Fill the bolt-holes with water and the carbon will float on top of the water and can be blown off with the breath or the tire pump.

The second method is to drop paper-fasteners into each hole with the points up. When the paper-fastener is pulled out the carbon which has dropped in comes out too.—G. A. LUERS.

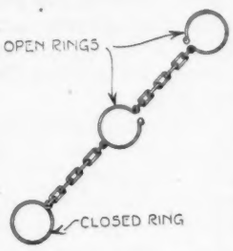
To Keep the Teapot Cover from Falling Off

HOW often has the china teapot cover fallen off, overturned a cup of steaming tea, and ruined the table-cloth, just because the cover had not been watched? But why watch the cover at all? Chain the cover down and it will not cause any accidents.

Such a cover guard consists of two short chains and three rings. The first is a closed ring and must fit loosely over the spout of the teapot. A chain just long enough to reach to the knob at the center of the cover is attached to the ring. The free end of the chain is provided with an open, flexible or spiral ring which fits around the stem of the knob. A second chain is attached to this ring and is cut

off so that it just reaches the handle of the pot. The third and last ring is attached to this end of the chain. This ring is also open and springy and fits around the handle. This completes the teapot-cover holder.

Insert the closed ring over the spout of the teapot. The middle ring is slipped over the knob of the cover, and the last ring is slipped around the handle. When this guard is in place, the teapot cover will not fall off nor slip off. The chain should be thin and not clumsy, and if it is made from brass, so much the better. Make the chain and the rings from uniform material, then the effect is so much more pleasing and will combine the useful with the esthetic.—E. BADE.

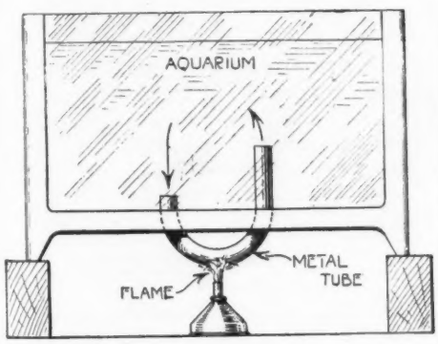


Ring chains like this may prevent a smash

Heating an Aquarium for Tropical Fish

TROPICAL fish require a temperature of at least 60° F. If they are kept in an aquarium, they will not thrive unless the water in the tank is constantly held at that temperature. This condition may be maintained by the use of a simple heating apparatus.

A metal tube, preferably of copper, is bent in the form of a U, but with one arm at least one inch longer than the other. Two holes are cut in the metal bottom of the tank, into which



This heating apparatus will make the aquarium a fit abode for tropical fish during cold weather

the two arms of the bent tube are fitted and soldered. The curve of the U should be at least one inch from the bottom.

The tank is raised by blocks of wood, so that a small alcohol lamp or a Bunsen burner may be placed under the curve of the U. It is best to place the lamp nearer to the longer arm of the U. The water in this tube, as soon as it becomes warm, rises to the surface. This causes the cold water to sink in the shorter arm of the tube. As it becomes heated it rises again, and in this manner constant circula-

Our new trade mark!

STANLEY
S.W.

Announcement

THE purchase by The Stanley Works of the Stanley Rule and Level Company will enable us to serve you in the future even more efficiently than in the past.

For more than 70 years the two Stanley Companies have been building steadily towards one end—to make the name STANLEY a mark of dependable quality in

Wrought Steel Hardware
and
Carpenters' Tools

A new trade mark as here shown has been established as the result of this merger.

The combined experience and facilities of these two great companies will hereafter be devoted to maintaining and increasing the service represented by the name STANLEY.

THE STANLEY WORKS

Main offices and plants:
NEW BRITAIN, CONN.

Branch offices:
New York Chicago San Francisco
Los Angeles Seattle

Metallurgy and Drop-Forgings

IN former days, the skill of the individual workman was almost the sole dependence in the production of drop-forgings.

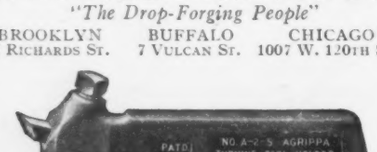
But for years past, to supplement with scientific knowledge the craftsmanship of their operators, Williams have maintained complete chemical and physical laboratories in charge of an experienced metallurgist. He selects the materials and prescribes the methods and temperatures to be used in manufacture. He knows, definitely, what results to expect; his laboratories tell him accurately whether or not they have been obtained.

Individual skill, backed by scientific knowledge, has made Williams' drop-forged machinists' tools—Wrenches, Tool Holders, Lathe Dogs, Clamps, etc.—*Superior.*

J. H. WILLIAMS & CO.

"The Drop-Forging People"

BROOKLYN 7 Richards St. BUFFALO 7 Vulcan St. CHICAGO 1007 W. 120th St.



WILLIAMS' "AGRIPPA" TOOL HOLDERS

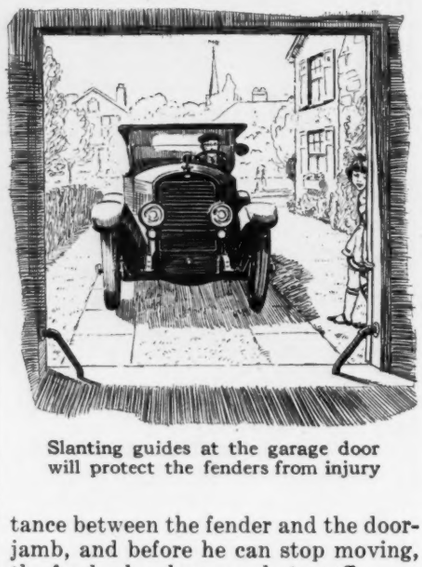
For all regular machining operations

Ask for Machinists' Tools Book

tion is established and an even distribution of the heat through the whole tank. The temperature is regulated by a thermometer and the size of the flame under the heating-pipe. During the winter the tank should be covered with a glass plate to keep the water at a more uniform temperature.

Do You Bump Garage Doors with the Mudguards?

VERY often you can identify the fellow who keeps his automobile in his own garage by the condition of the fenders of his automobile. They are bent down somewhat, or dented, and otherwise disfigured, because in driving in or backing out of his garage he has a habit of misjudging the distance between the fender and the door-jamb, and before he can stop moving, the fender has been made to suffer.



Slanting guides at the garage door will protect the fenders from injury

Where the doorway is none too wide—a natural condition with the city man's garage, since usually he cannot make it any larger than necessary to barely squeeze the car in—it is a good idea to install guard rails in the corners of the door opening or little concrete or wooden guiding-blocks. If a piece of husky piping is attached at each corner it will serve as a guard against which the tire will strike if the automobile is run too close to the doorway. This will either have the effect of pushing the automobile over away from the side of the door, or it will offer enough obstruction to the forward movement of the automobile to warn the driver in time to change the automobile's position. Obviously, these diagonal pipes would only be of advantage when entering the garage, being of no service when backing out.

The concrete or wooden blocks, however, are intended as backing-out protection, serving to guide the wheels in the path they should follow in order to clear the doorway sufficiently. They are of no special advantage when entering the garage, being opposite in their function to the diagonal pipe fenders mentioned above.

How to Test Rubber Rings for Preserve-Jars

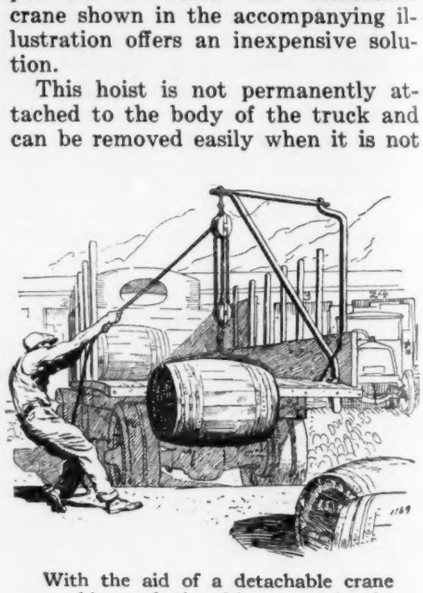
RUBBER rings used in canning or preserving may be tested by simple methods. Cut a 6-in. piece out of a ring and, taking hold of the ends so that 4 in. remain between the fingers, stretch the piece along a ruler until the fingers are 10 in. apart. When released, the sample should return to its original length and should not break.

Another method of testing is the following: Fill a light weight pail with 1 gal. and 7 pt. of water, or the equivalent of approximately 17 lbs. Place the jar-ring around an empty spool, then pass a wire through the center of the spool and fasten to the handle of the pail. Pass a broom-handle through the ring and lift. If the ring does not break, there is not much danger of its giving trouble in canning.

A Detachable Crane for Use on the Truck

HOW to avoid the necessity of employing an assistant to the truck-driver for loading and unloading heavy and bulky goods is a problem of which the detachable crane shown in the accompanying illustration offers an inexpensive solution.

This hoist is not permanently attached to the body of the truck and can be removed easily when it is not needed for handling heavy freight parcels. The main support of the crane is a heavy pipe, which is held in a vertical position by two brackets bolted to the end of one of the side boards of the truck. The pipe is held at the proper height by a supporting pin which rests on the upper bracket. The upper part of the pipe is curved in the shape of an S and has at its end a vertical pin which forms the upper pivot of the crane.



With the aid of a detachable crane on his truck the driver can do the loading and unloading without a helper

The crane is also made of heavy pipe and is bent as shown in the accompanying illustration. The end of the upper arm is flattened and provided with a hole into which the

A Butt-Hinge Serves as an

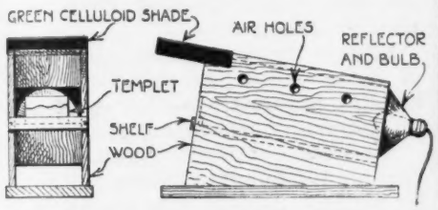
boot will cling closely to it and seem to

vertical pivot pin of the main support fits. The end of the lower arm is slightly bent and fits over the center stud of a flange-plate which forms the lower pivot. To the elbow of the pivoted crane the hoisting tackle, which may be of any suitable type, is attached.—G. A. LUERS.

A Handy Templet Stand for Accurate Work

THE making of templets has been, and always will be difficult, for a templet, to be of any use, must be accurate, expecially when it is made of two pieces, one of which must coincide with the other.

Having found it difficult to hold such work to the light to ascertain if everything was as it should be, we



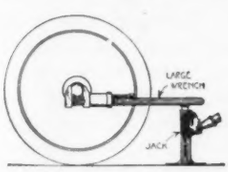
You will save your eyes and insure greater accuracy by using a templet stand like that shown here

constructed the stand as shown in the accompanying sketch. The stand was made of wood.

In action we placed the pieces to be fitted on a little shelf in front. In the rear was an electric light and a reflector. A shade, made from a piece of green celluloid, relieved the strain on the eyes. Near the top were air holes, so that the heat of the light would not injure the wood.—J. H. MOORE.

Conquering that Stubborn Automobile Hub-Cap

SOMETIMES it is very difficult to remove the hub-cap, even when a large wrench is used for the purpose. This is usually due to water which found its way to the threads of the cap and formed rust. In that case, make use of the jack as shown in the illustration.



A long-handled wrench and a jack form a powerful combination

Procure a long-handled wrench so as to obtain greater leverage, and place the jack under the end of the handle. A few strokes of the jack will start the most stubborn hub-cap. This method is equally successful with big trucks, using the jack furnished with the truck.

When removing wheel-nuts, you should bear in mind that the nuts have right-hand threads on the left side and left-hand threads on the right side of the hub.—R. L. PRINDLE.

Back of Every Brown & Sharpe Tool

70

The reputation and experience of 70 successful years in the manufacture and sale of fine tools

Send for new Catalog No. 28-380 pages

BROWN & SHARPE MFG. CO. PROVIDENCE R.I. U.S.A.

30 Days' Free Trial

Select from 44 Styles, colors and sizes, famous Ranger bicycles. Delivered free on approval, from maker - direct - to - rider, at Factory Prices. Save $10 to $25 on your bicycle.

12 Months to Pay Immediate possession on our liberal Easy Payment plan. Parents often advance first deposit. Energetic boys earn the small monthly payments thereafter.

Tires Horns, wheels, lamps, parts and equipment at half usual prices.

SEND NO MONEY—Ask for big free Ranger Catalog, marvelous prices and terms.

Mead Cycle Company Dept. H109 Chicago

Special offer to Rider Agents

ASBESTOS

We are miners and shippers of Crude Asbestos in any quantity. We produce all grades at our world famous BELL ASBESTOS MINES, in Canada. We also card fibres, spin yarns, weave cloths, and make all sorts of Asbestos products.

For anything you want in Asbestos, turn to

KEASBEY & MATTISON COMPANY

Dept. S-4. AMBLER, PENNA., U. S. A.

Owners of the world's largest Asbestos Mines

$6000 a Year is Your Profit

from four sales a day. No experience needed. Largest concern of its kind in the world. Davidson sold 96 in one week. Flynn 72 in three weeks spare time. Boyce 25 in one evening. New Aladdin light is a sensation wherever introduced. Five times as bright as electric. Won Gold Medal. Approved and used by U. S. Government. Endorsed by 35 leading Universities. Farmers have the money, they need this light, and 9 out of 10 will buy. Also big opportunity in small towns and suburbs. Excellent spare time and evening seller. NO CAPITAL REQUIRED. Sample on free trial. Write for agency proposition and exclusive territory.

M. O. Johnson, Sales Manager, 609 W. Lake St., Chicago

Pilliod

TOOL CASES EXCEL

Machinists, Tool Makers and Carpenters find them most satisfactory in construction, appearance, service and price. Immediate shipment.

Booklet describing 20 styles on request.

The Pilliod Lumber Co.

Dept. A, Swanton, Ohio

LATEST OUT

Log and Tree Saw

NOW you can get the latest WITTE Arm Swing, Lever Controlled, Force Feed Log Saw for sawing up logs any size. Moves like a wheelbarrow—goes anywhere—saws up-hill, down-hill or on level. Cuts much faster than former rigs. Operated by a high power, frost-proof

WITTE 4-Cycle Engine

Costs only 25 to 50 cents a day to operate. Double the power needed for sawing logs or trees. Perfectly balanced rig. Can be used for belt work.

New WITTE Tree Saw

At low cost additional you can now get the new WITTE Tree Saw Equipment—changes Log Saw to Tree Saw. Saws down trees any size.

Send for Log and Tree Saw Catalog.

Quick Change From Log to Tree Saw

$125.00 NOW

For this Complete Log Saw

F. O. B. Kansas City, Mo. From Pittsburgh, Pa., add $6.80

Don't buy any Log Saw, Tree Saw or Buzz Saw Outfit until you have seen the new WITTE. Lowest priced Guaranteed rig on the market. Cuts much faster than former rigs. On tests we cut 2-ft. log in 90 seconds. Tree saw cuts 'em close to the ground. Goes anywhere. We are making a special advertising price NOW—So write at once for complete description of this wonderful outfit FREE. BRANCH BUZZ SAW $23.50.

WITTE Engine Works

2226 Oakland Ave., Kansas City, Mo.
2226 Empire Bldg., Pittsburgh, Pa.

January, 1921

Always Experimenting for Production-gains

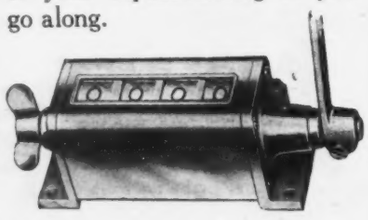
The true mechanic never finishes with developing his machines; in process or in service he's making them *better producers*—as Veeder Counters register his progress.

Veeders count the product as your machines work; show the production-rate over a given period; record the effects of changes in mechanism or operating method.

You get the measure of your machine and the data for its further development, when a

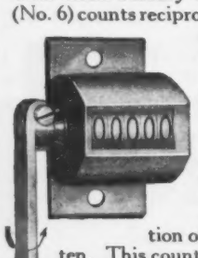
Veeder COUNTER

sets before you the exact *result* of your experimenting as you go along.



The above Revolution Set-Back Counter records the output of any machine where a shaft revolution indicates an operation. Sets back to zero from any figure by turning knob once round. Supplied with from four to ten figure-wheels, as required. Price with four figures, as illustrated, $10.00 (subject to discount). *Cut less than one half size.*

This small Rotary Ratchet Counter (No. 6) counts reciprocating movements of the lever, as required in recording the output of punch presses. When the lever is moved through an angle of 40 to 60 degrees, the counter registers one. A complete revolution of the lever registers ten. This counter is adapted to no end of small machines, simply by regulating the throw of the lever. Price, $2.00. (*Cut nearly full size.*)



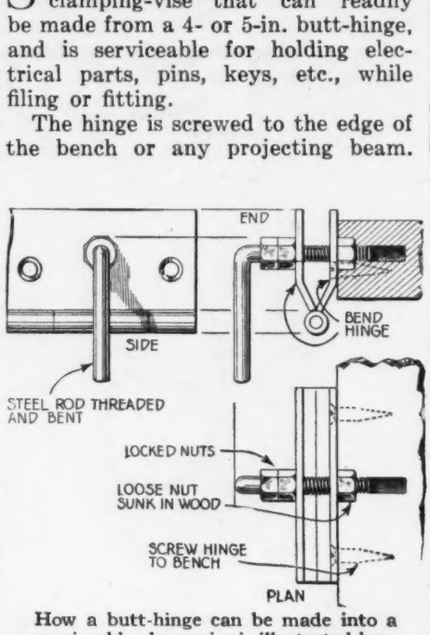
Veeder Counters for every conceivable purpose may be seen in a booklet, "Checking Up Production." *Write if you haven't a copy.*

The Veeder Mfg. Co.,
44 Sargeant St., Hartford, Conn.

A Butt-Hinge Serves as an Improvised Vise

SHOWN in the illustration is a small clamping-vise that can readily be made from a 4- or 5-in. butt-hinge, and is serviceable for holding electrical parts, pins, keys, etc., while filing or fitting.

The hinge is screwed to the edge of the bench or any projecting beam.



How a butt-hinge can be made into a serviceable clamp vise is illustrated here

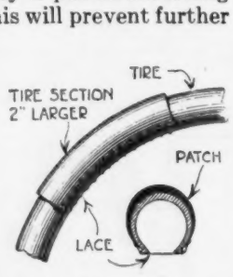
The edges are bent by inserting a piece of steel between them and hammering. A bent and threaded rod with three nuts is the means of closing the jaws. This fixture is made up in a few minutes and is serviceable for the odd light jobs about the automobile shop.—G. A. LUERS.

Save the Tires by Using a Laced Boot

THE tire is one of the weakest features of the automobile. A small puncture may cause a blowout; a sudden stop may produce a weak place in the tread. Usually the shoe that is discarded shows a thin spot 6 to 18 in. long, while aside from this it is in good condition.

You can make a durable lace-on boot that will stay if put on according to directions. This will prevent further wear of the weak part and lengthen the life of the tire.

To make the lace-on boot, secure a portion of another tire, preferably one that is two inches larger in diameter. Wet it, and with a sharp knife slice off the beads or clinchers and an inch of the side adjoining. Then with a belt punch make clean holes every three inches. Pass a good belt-lace through these holes and lace the boot over the worn part of the tire.



A laced boot will prolong the life of any injured tire

When the tire is inflated, the lace-on boot will cling closely to it and seem to be a part of it.

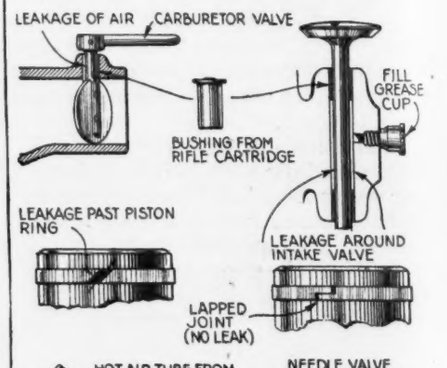
If the shoe is in good condition except in one weak spot, wash this well with gasoline, spread it with liquid rubber cement. Let this dry, and repeat. Next lash on the boot prepared on the inside in the same manner and the heat generated by running will vulcanize the two together. This is especially desirable in a driving-wheel tire.—HOLLISTER SAGE.

Keeping the Carburetor in a Good Humor

MUCH has been written about the difficulties of carburetion under normal conditions, when the engines under consideration are in good shape; but the difficulties are even greater in the case of engines that have been used for a long time.

Some of the common complaints are of the so-called "galloping engine's" inability to throttle to a low speed and an unaccountable missing or skipping.

Air-leaks diluting the gasoline vapors are the foremost causes of irregular action. Seldom does the air leak



Air-leaks in the carburetor and the intake valves make the engine miss fire

through a loose gasket, but the hole through which the stem of the throttle valve protrudes, due to wear, provides an air leak that should be remedied. Take the lever off, bush the hole with the shell of a rifle cartridge or similar piece of tubing to keep the air penetrating at this point. Now remove the intake valves, discard the exhaust valves and use the intake valves in their place. Purchase new intake valves and if these do not fit the holes snugly, ream the extreme ends of the valve guide and place a copper or brass bushing at each end or entirely through if desired.

Fit a small grease-cup and use a graphite grease, and the leakage of air at this place will be overcome. Remove the piston-rings and fit new ones with lapped ends that will effectively stop all leaks at this place. The next

change is in the carburetor, which modification will vary with the different makes. To make the carburetor atomize the fuel better, it is necessary to restrict the opening surrounding the spraying needle.

In some carburetors a removable tube is used which can be taken out and bushed or given a heavy coating of solder to close the opening. The object is to narrow the opening and to give to the stream of entering air greater velocity. If the carburetor has no preheater, one should be added.

With the carburetor removed, push the butterfly throttle valve to its closed position and note the small opening through which the engine gets its fuel, which will give you some idea of the importance of closing the small openings that give a combined area sufficient to dilute the mixture until it will not burn, which accounts for the skipping of the engine in many cases.—GEORGE LUERS.

This Burning-Glass Is a Piece of Ice

SUPPOSE you go fishing some cold day and find that you have no matches with which to start a fire—what would you do? If you have a jackknife with you and can find a piece of nice clear ice about 1 in. thick and 4 in. across, you need have no cause for worry.

Ice is as good as glass for making a burning-glass in winter

Carve out a roughly shaped double convex lens somewhat like the style shown in the sketch. Then rub it between the palms of the hands until the bodily heat melts away the roughness and it assumes a smooth surface on both sides similar to a glass lens.

By focusing the rays of the sun on a bit of tinder, such as dry wood, pith, paper, etc., a flame can soon be produced that only needs to be fanned carefully and fed with combustible material to yield a good fire.

If it is desired to use this lens several times during the day, dip it in water occasionally, which will smooth it and form a new film of ice on its surface, thus keeping it up to size.—L. B. ROBBINS.

Cutting Wire to Length in the Lathe

WHERE a great number of pieces of wire or small rod have to be cut to the same length, the work can be quickly and conveniently done in the lathe.

Take a piece of brass or iron that will go into the tool-post and drill

Use Starrett Tools

TURN to the INDEX

THAT'S the quickest way to learn how much vital information it contains. But only constant use will teach you the full value of the STARRETT DATA BOOK FOR MACHINISTS.

Experts selected its tables and formulas to meet the requirements of practical machinists. Useless matter has been eliminated, with the result that each of its 180 pages will aid you to solve some specific problem. It is the logical sequel to the Starrett Book for Machinists' Apprentices, now in its fourth edition.

180 pages, bound in red Athol leather. Numerous tables and diagrams. Size 4½ x 7. Price 75 cents.

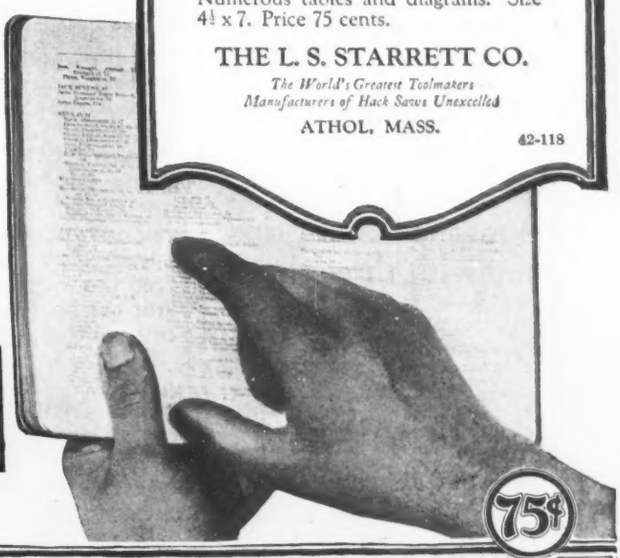
THE L. S. STARRETT CO.

The World's Greatest Toolmakers
Manufacturers of Hack Saws Unexcelled

ATHOL, MASS.

42-118

For the Machinist Apprentice Vol. I of The Starrett Books is invaluable. It deals with how to use tools and is an instruction rather than a reference book.



75¢

Starrett Books - Vol. II

Dies; Their Construction and Use for the Modern Working of Sheet Metal

By J. V. WOODWORTH. The latest practice in the working of sheet metals. It shows how dies are designed, made and used. 525 illustrations, 394 pages..... Price, $3.50

Popular Science Monthly - 225 West 39th Street, New York

CONSTRUCTION OF INDUCTION COILS AND TRANSFORMERS, by Thomas Stanley Curtis. Full of practical notes and instruction. Tells you both the why and the how. Little is left to guess work. Open and closed core transformers are both taken up. For a practical instruction book on the whole subject this one is hard to beat for the price. Price, postpaid, 25 cents

POPULAR SCIENCE MONTHLY

225 West 39th Street New York

NEW MOTORS FACTORY GUARANTEED ALL SIZES PROMPT DELIVERY

Charging Generators
Suitable for all lighting, Battery Charging and Power Requirements.

8 v., 10 amp.	$19.50
15 v., 10 amp	$26.50
40 v., 6 amp.	$31.50
110 v., 2½ amp.	$31.50
110 v., 5 amp.	$52.50
40 v., 12 amp.	$52.50
110 v., 9½ amp.	$67.50
40 v., 25 amp.	$67.50
110 v., 18 amp.	$116.50
40 v., 50 amp.	$116.50
110 v., 26 amp.	$156.50
110 v., 50 amp.	$238.50
Moving Picture Arc Generator 60 v., 35 a.	$116.50

Polyphase Motors
2 and 3 phase, A. C., 220 v. 60 c., 1750 R.P.M., Complete with base and pulley.

½ H.P.	$46.50
1 H.P.	$66.50
2 H.P.	$86.50
3 H.P.	$98.50
5 H.P.	$116.50
1 H. P. Special Grinding and Buffing Motor	$106.50

Direct Current Motors
110 or 220 volts, D. C., shunt wound, 1750 R. P. M. With base pulley and starting box.

¼ H. P. Washing Machine Motor	$28.50
¼ H. P., 32 v. Washing Machine Motor	$28.50
½ H. P.	$58.50
1 H. P.	$82.50
2 H. P.	$124.50
3 H. P.	$142.50
5 H. P.	$218.50

Single Phase Motors
110-220 volts, A. C., 60 cycle, 1800 R. P. M. with pulley

¼ H. P., 220 v. induction Washing Machine Motor	$28.50
¼ H. P., 110 v. grinding buffing motor	$28.50
½ H. P. induction, full load start	$46.50
½ H. P. repulsion induction For compressor service	$54.50
1 H. P. repulsion induction, Special Garage Motor	$74.50
2 H. P. repulsion induction with sliding base	$126.50
3 H. P. repulsion induction with sliding base	$146.50
5 H. P. repulsion induction with sliding base	$188.50

WRITE FOR CATALOG. BARGAINS IN MOTORS AND GENERATORS

1/4 SPECIAL H.P. 110 volts A.C., 60 c. S. P., 1750 R.P.M. Complete, cord, plug and pulley

WASHING MACHINE MOTORS Suitable for operating Small Compressors, Coffee Grinders, Bottle Washers, Etc. $26.50 Each! Reg. Val. $34.50

MONEY BACK GUARANTEE

SHIPPING TERMS: 25% deposit required on all orders. Balance C. O. D. by Express. Sight draft with Bill of Lading attached by freight.

MANUFACTURERS' DISTRIBUTER

CHAS. H. JOHNSTON, Box 14, West End, Pittsburgh, Pa.

Red Devil
REG. U.S. PAT. OFF.

Corrugated Lock-Washer

6 Point Contact

THE Red Devil Corrugated Lock Washer has six points of contact. This means that it grips the nut with three times the number of points that other lock washers do.

Furthermore, 1¼ turns are required to loosen it, and a ¾ turn will loosen the usual lock washer. This means 66⅔% greater efficiency.

Extreme vibration will not loosen a Red Devil Lock Washer.

Made of manganese steel, oil tempered, and with a blue gun metal finish.

At your dealers or from us direct

Sample Assortment	*Retail Price*
No. 103—30 in a bag, 3-16" to 5-8"	.15c
No. 140—40 " " " " "	.20c
No. 190—90 " " " " "	.25c

Smith & Hemenway Co., Inc.

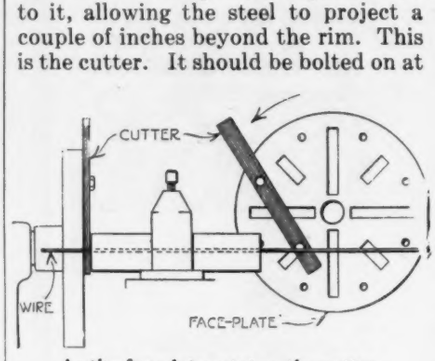
264 Broadway :: :: New York City

Factories, Irvington, N. J.

Booklet on request

Mechanics', Electricians' and Motorists' Hand Tools, Pliers, Glass Cutters, Hack Saw Frames and Blades, Auger Bits, Chain Drills, etc., etc.

a hole through it lengthwise that will just allow the wire to pass through without play. Clamp it in the tool-post parallel with the bed of the lathe. Put a small faceplate on the spindle nose and bolt a piece of square steel to it, allowing the steel to project a couple of inches beyond the rim. This is the cutter. It should be bolted on at



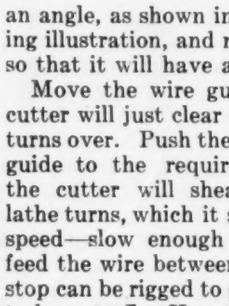
As the faceplate rotates, the cutter shears the wire in equal lengths

an angle, as shown in the accompanying illustration, and not on the radius, so that it will have a shearing action.

Move the wire guide up until the cutter will just clear it when the lathe turns over. Push the wire through the guide to the required distance and the cutter will shear it off as the lathe turns, which it should do at slow speed—slow enough to give time to feed the wire between cuts. A simple stop can be rigged to govern the length to be cut off.—HOWARD GREENE.

One More Way of Testing Lathe Alinement

A GOOD test for the alinement of lathe centers may be made by the disk method. Use a perfectly flat disk of metal about ⅛ in. thick and in the center drill a very small hole—say 1/16 in. Make sure that the hole is clean and that it is at right angles to the surface.



If the disk wabbles the lathe-centers do not run true

Put the disk between the centers and run the lathe. If the centers are in line, the disk will run true. If they are out, the disk will wabble.

In making this test, the centers themselves must be round and true.

Economical Fuel Bricks that May Be Recharged

ORDINARY building-bricks provide a compact and economical source of heat for cooking.

Merely allow the brick to soak up kerosene and the fuel is ready for use.

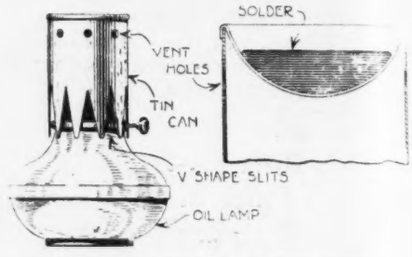
These fuel bricks will burn several hours, and give out a strong heat.

Do not re-charge the bricks until they have become quite cold, otherwise there will be waste through evaporation.—GEORGE H. HOLDEN.

Soldering with the Aid of an Oil Lamp

THE accompanying picture conveys a valuable suggestion to automobilists who often meet an emergency in which they have to solder the broken wires of their lighting or ignition circuits. The picture shows a simple method which may be easily and quickly improvised, provided the car is equipped with an oil lamp, such as is used in the parking light.

A baking-powder tin is another essential requirement. Cut several V-shaped slits in the edge at the open end and punch a few holes in the sides near the closed end. With a hammer indent the top so as to form a shallow dish, large enough to hold the solder



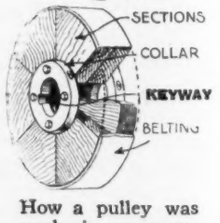
Solder may be melted in an emergency indented bottom of a tin can

which is required for the work. Light the lamp, place the tin with the solder over it and in a few minutes the solder will be melted. The wires are soldered by dipping the ends into the molten metal.—G. A. LUERS.

An Emergency Repair to a Broken Pulley

IT is a well known fact that the instant anything breaks is the time you need it most.

One of our line-shaft pulleys broke suddenly and we were in a bad plight as we could not secure a pulley from any store in town, because it was 20-in. diameter, 6-in. face, and 2 15/16-in. bore. Something had to be done or a machine would go out of commission, a line of them in fact, all driven from this line-shaft.

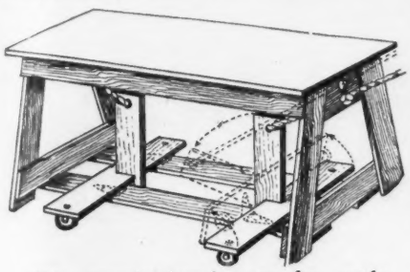


How a pulley was made in an emergency

How we got out of this difficulty is shown by the illustration. We asked our pattern-makers to saw us twelve sections as shown, each section out of 3-in. thick lumber. These were all nailed together and a belt bound around the outside of the make-shift pulley. Next we fastened two collars with a 2 15/16-in. bore on each end, then cut the right size of keyway.

Equip the Laundry-Bench with Rollers

THE accompanying sketch shows an improvement which may be added to benches of all kinds; but more especially to benches used in the laundry. Some washing-machines do not have a swinging wringer, and a bench of this kind will save much lifting, and is so inexpensive to make, that every home



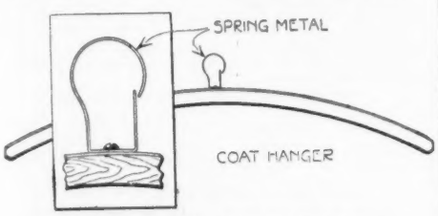
This laundry-bench can be made movable or stationary, as it may be needed

laundry should have one. A short pull on the rope until the knot catches in the slotted hole at the end of the bench puts the bench on rollers and a heavy load can be moved surprisingly easy.

When a solid, immovable bench is desired, the rope is released, and the legs rest firmly on the floor, for the weight causes the rollers to move up, as is shown by the dotted lines. Four casters, two pairs of ordinary strap hinges, and the necessary lumber is all the material required to make one of these time- and labor-saving articles.—ARTHUR M. HAHN.

Put Snap-Hooks on Your Clothes-Hangers

UNLESS they are carefully handled and properly shaped, clothes-hangers will often become dislodged and slip off the pole or line to which they are hooked. A snap-hook, which you can easily make from a piece of spring metal, strong enough to support



Snap-hooks like this make your clothes-hangers a great deal more efficient

the weight of a coat or suit, will prevent the hanger from slipping off from its support.

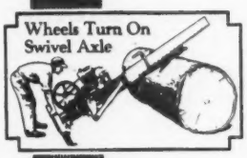
Take a piece of spring metal, either iron or brass, heat it to take out its temper, then bend it as shown in the accompanying illustration. Also drill a hole in the straight part which forms the base of the hook. Reheat the shaped metal and restore its springiness by quenching it in oil. It will then be ready to be fastened to the hanger.—H. E. MENDE.

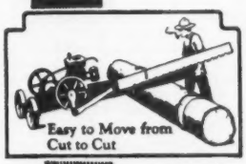
Special Offer Now—Wholesale Factory Prices!

Friction Clutch
310 Saw Cuts a minute!
Used in U. S. Navy and in Gov't Schools
Steady, Sure Smooth Power At All Times
Strictly a One-Man Outfit
Cuts Down Trees Level With Ground
5 Seconds to change from Log Saw to Tree Faller and Back Again
Pat. Appl'd For
Easy to Move

Make Big Money

With the OTTAWA Log Saw. Have plenty of fuel for yourself and to sell. Make $300 to $500 a month as others are doing. All done without hard work. You sit and rest while the OTTAWA does the hard work of sawing. Cuts mine props, railroad ties, fence posts, shingle timber, stave bolts and ice. When not sawing, engine runs belt machinery. Get Big Special Offer Now—Lowest Factory Price—Less than Wholesale.





OTTAWA LOG SAW

Cuts Down Trees—Saws Logs By Power

Pulls Over 4 H-P. The New Improved 1921 Model OTTAWA makes 310 Saw Cuts a Minute—over 5 each second. Weighs 100 pounds less than any other 4-cycle log saw built. Easiest to move and operate of all log saws. Counter Balanced Crank Shaft eliminates vibration, increases power and saves fuel. Direct gear drives saw; no chains to tighten; no keys; no set screws. 4-Cycle Frost-proof engine. Built-in Magneto—no batteries. Automatic Governor with Speed Regulator. Eccentric gives human rocking motion, keeping cut free from saw dust. Outfit strong but simply built. Nothing to get out of fix. A great work-saver and money-maker.

Friction Clutch lever controlled, roller bearing, enables you to start and stop saw blade without stopping engine. Saves time and provides absolute safety in moving saw from log to log and from cut to cut along log! No dangerous swishing of the saw blade in the air! Second clutch provided as a safety clutch to prevent accident if saw blade should bind.

30 Days' Trial—10-Year Guarantee. Every OTTAWA shipped on Thirty Days' Trial. Must fulfill Ten-Year OTTAWA Guarantee. For nearly 20 years we have been selling direct from factory to users. Now over 15,000 satisfied users.

Cash or Easy Payments. Get our liberal payment plans of purchase and find out how easy it is to own an OTTAWA Log Saw. Soon pays for itself. Any man with logs to cut cannot afford to be without this Log Saw. You can easily own it under our wonderful selling plan.

Special Offer Now—Wholesale Factory Prices! To enable as many as possible to provide fuel for themselves and to sell, we are making a Special Offer at Wholesale Factory Prices. Send for it at once! Don't delay! Just put your name and address on coupon and you will receive promptly complete information about this Big Special Offer and Very Low Introductory Price.

OTTAWA MFG. CO., 1807 Wood Street Ottawa, Kansas

Write Today for FREE BOOK!

We have prepared a 32-page book which you may have free. It illustrates in full color the OTTAWA Log Saw, taken from genuine photographs and showing all details of construction. Be sure and send your name and address on coupon so that you will receive your copy promptly.

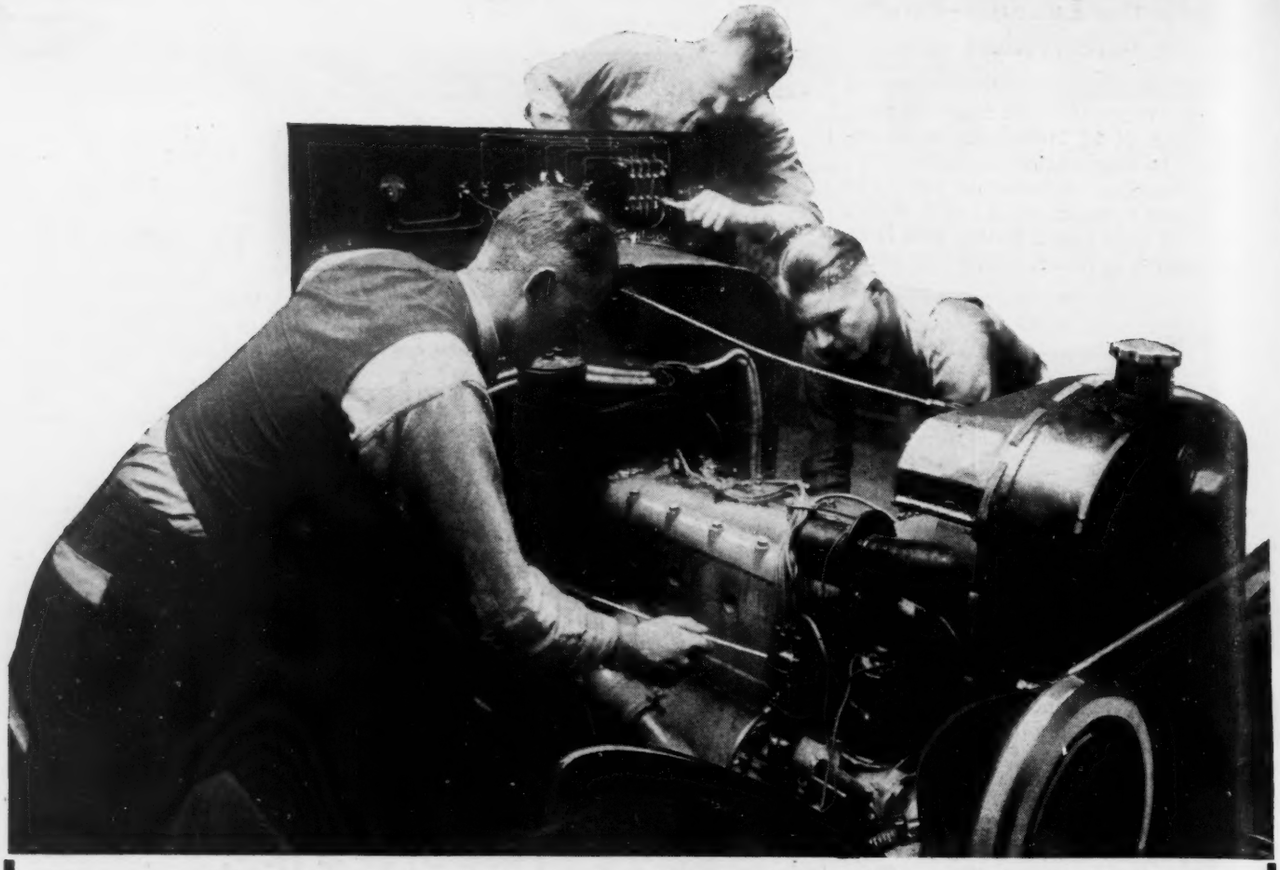
MAIL THIS NOW

OTTAWA MFG. CO.,
1807 Wood St., Ottawa, Kans.

Send me your Free Book and Big Special Offer on 1921 Model OTTAWA Log Saw. It is understood I am under no obligations.

Name.....

Address.....



Be a Trained Man—The M. S. A. S. Kind

MAKE $500 A MONTH AND MORE

THE opportunities for properly trained men in the Automobile and Tractor business are positively unlimited. Ten million or more automobiles, trucks and tractors in use in America, and the production of several million more each year offers a future for trained men that is unparalleled in history.

If you are ambitious to get out of the rut and have **a business of your own,** there never was a better opportunity than right NOW in the Automobile and Tractor Business. There are thousands of excellent openings in good territory for garages, repair shops, and service stations.

Tremendous Demand for Detroit Trained Men

Ask any of our graduates, they will tell you that just as soon as they arrived home, they had more work offered them than they could handle.

$500 a month is not an unusual profit for M. S. A. S. graduates who are in business. Thousands of openings in good territory await you. Get our catalog and learn more about the wonderful opportunities for Detroit trained men.

Packard Motor Car Company
MADE IN AMERICA
DETROIT, MICH., U.S.A.

The Michigan State Auto School enjoys a very enviable reputation and is probably one of the best of its kind in the United States. Have no hesitation in recommending it in every particular. Yours very truly,
PACKARD MOTOR CAR COMPANY

Our free catalog contains many letters from manufacturers. Send for it today.

M. S. A. S. TRAINING

covers every point of knowledge and practice required of a successful automotive expert. We teach automobiles and tractors from A to Z. Very thorough and complete training in electrics. Actual experience in assembling, block testing, bearing scraping, repairing, including batteries. Tractor training, with actual field practice on M. S. A. S. tractor farm, included in complete Auto Course. Our equipment and training are positively the best obtainable.

Brazing and welding and tire-repairing are also taught.

The M. S. A. S. can teach you how to conduct a business of your own successfully. How to repair and sell cars, how to judge used car values and give you the necessary pointers in garage management, equipment, etc. Graduates are life members, with all service advantages free. You can return any time and "brush up" on new equipment free of charge.

OPPORTUNITIES FOR YOU

Start a Garage, Repair Shop or Service Station. Little capital is required when you know your business. You can sell cars, tractors and all kinds of accessories in connection.

Repair and Operate Tractors. Many of our graduates train and go back to the farm. Big money in this work.

Factory and Other Positions Open. Real trained men are also needed.

Be a Salesman. Complete and thorough knowledge of the business gives M. S. A. S. graduates a great advantage over the ordinary salesman.

Have a Tire Repair Shop. Think of the tremendous number of tires that require repairing each day in your district. Just multiply the number of cars by four.

Brazing and Welding is a good trade, too. Splendid opportunities for shops.

Or Be a Lighting Plant Expert. Many positions open for service and installation experts in the farm lighting plant field.

LEADING MANUFACTURERS ENDORSE AND RECOMMEND OUR SCHOOL. They have placed their machines with us for the instruction of students. They are constantly sending us students and calling for graduates.

Here Are a Few Examples from Our Thousands of Successful Graduates

J. S. Steckel, of Coplay, Ill., was a loom fixer at $18.00 a week. He trained at the M. S. A. S. and now he has a garage of his own paying a profit of over $100 a week.

W. F. Harms, of Eldridge, Iowa, was a farm hand at $35.00 a month. Today, after training at M. S. A. S. he has a garage business and three helpers; profits are $500 a month.

Before training, Byron Hulton at Floyd, Va., was working for $40 a month. Now he has a half interest in a garage business that pays a profit of over $1,000 a month.

Before training at M. S. A. S., H. A. Bradley, of Cleveland was a shipping clerk at $12.00 a week. Now he has a business of his own in Cleveland, monthly profits over $500 a month.

Tony Dandrea, Austin, Pa., was a common laborer. Now he has a garage with more business than he can handle with three men.

C. F. Swanson, of Sioux City, Ia., was working by the day. Now his profits run $520 a month in garage and car sales.

Martin Vander Bie and F. E. Dulyea, of Holland Michigan, M. S. A. S. graduates, have one of the best garages in Western Michigan.

MONEY BACK GUARANTEE

We guarantee to qualify you for a position as chauffeur, repair man, demonstrator, auto electrician, garage man, automobile dealer, tractor mechanic and operator or farm lighting expert, paying from $125 to $400 monthly, or refund your money.

FREE BIG 124-PAGE CATALOG

Send the coupon today for big 124-page illustrated catalog and copy of latest "Auto School News." They tell about Courses—show more than a hundred pictures of equipment—give letters from big Auto Factories and stories of success from graduates and opportunities for you. Use coupon NOW.

Send This Coupon Today

MICHIGAN STATE AUTO SCHOOL
551 Auto Building, 3729 Woodward Ave., DETROIT, MICH.

Gentlemen: Please send me absolutely FREE New 124-page Illustrated Catalog, also "Auto School News" and information as checked below. (Mark each course you are interested in.)

- [ ] Auto and Tractor Course
- [ ] Tire Repairing
- [ ] Brazing and Welding

Name.....

Street.....

City..... State.....

P. S.—Or, better still, you can expect me to look over your school.

Date.....

DETROIT

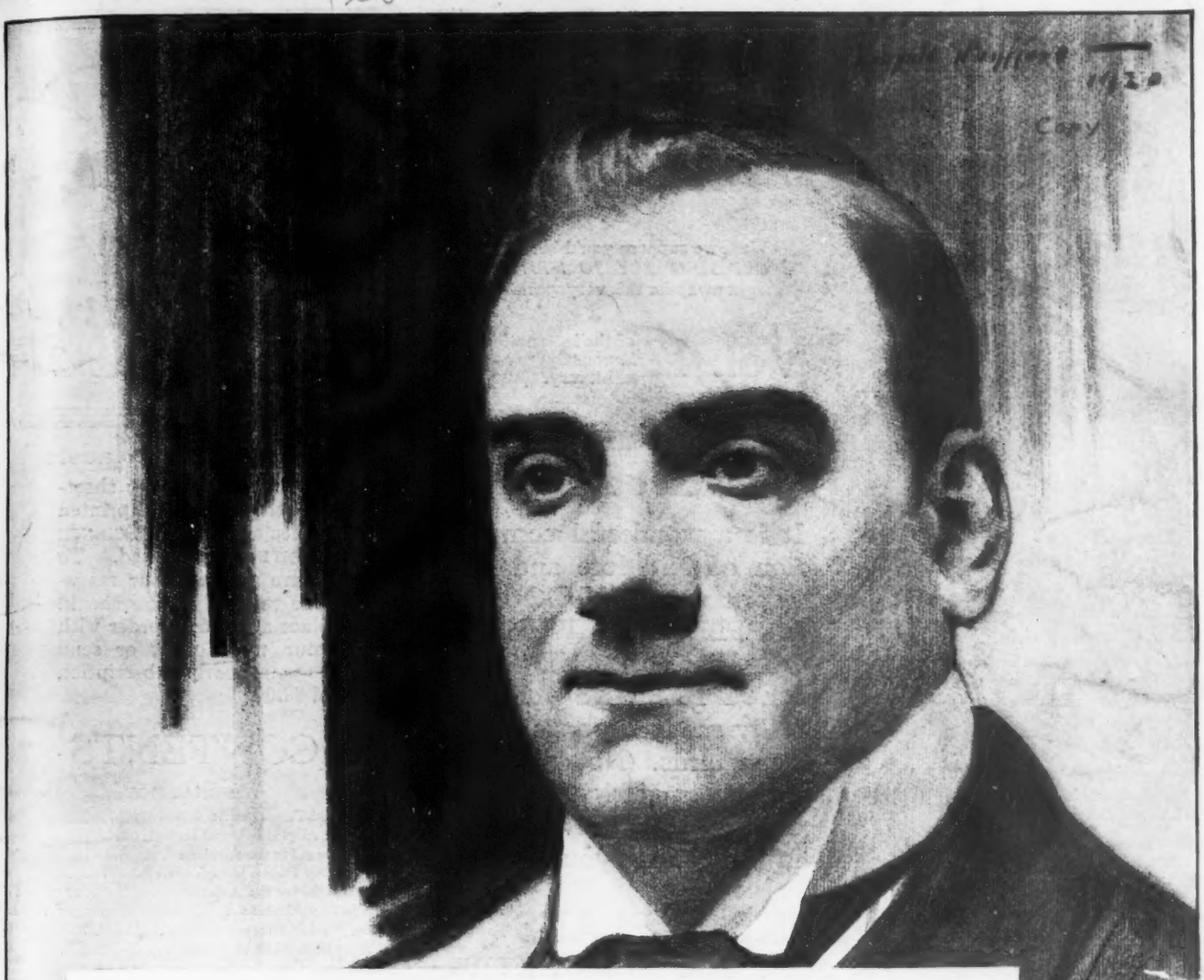
THE AUTO CENTER is the logical place to LEARN the AUTO and TRACTOR BUSINESS. 94% of automobiles are made in Detroit district, the world's greatest automotive experts are here.

MICHIGAN STATE AUTO SCHOOL

"The Detroit Auto ool"—*"In the Heart of the Auto Industry"*

581 Auto Building
3729 Woodward Ave.

Detroit, Mich., U.S.A.



AFTER PHOTO © HISHKIN

Caruso immortalized

A vast heritage of arts and literature has been bequeathed to the world by the passing centuries, but it remained for the Victrola to perform a similar service for music.

It has bridged the oblivion into which both singer and musician passed. The voice of Jenny Lind is forever stilled, but that of Caruso will live through all the ages. The greatest artists of the present generation have recorded their art for the Victrola, and so established the enduring evidence of their greatness.

There are Victrolas from $25 to $1500. New Victor Records on sale at all dealers on the 1st of each month.

Victrola

REG. U.S. PAT. OFF.

Victor Talking Machine Co.

Camden, New Jersey

This trademark and the trademarked word "Victrola" identify all our products. Look under the lid! Look on the label!

VICTOR TALKING MACHINE CO.
Camden, N. J.

NEW - Vol. 42 in the Famous Cypress Pocket Library!

The Cypress Bird-House Book

20 Working Plans on double supplement

2 rare portraits of AUDUBON on special supplement. Suitable for framing

Well, we suppose you'd better *GET THAT BOY TO WRITE* right away for this very special

Vol. 42 of the internationally famous Cypress Pocket Library. Just out.

"Good Bungalows for Good Birds."

It is a wonderful compilation of bird lore and bird information. BIG DOUBLE SUPPLEMENT WITH 20 BEAUTIFUL AND CORRECT DESIGNS—all specially made by artists who know birds. (Not one is like the other good designs in bird house catalogs.) Also in this volume you will find

20 FULL WORKING PLANS

with Complete Specifications. And ALSO EXTRA ART SUPPLEMENT, 12 x 29 inches, in **FIVE COLORS** with a total of

3 PORTRAITS OF AUDUBON

SUITABLE FOR FRAMING, two of them being reproductions in 5 colors of 2 rare old steel engravings, also photograph of his home and of the Statue to his memory. ALSO

5 BIRDS in NATURAL COLORS

and 180 correct pen portraits of other birds—with calls.

"Your Cypress Volume 42 is one of the most complete and authentic books on this subject I have ever seen." Thus recently wrote a bird-lover who has read much.

You will be astonished and delighted with the variety of the contents of Vol. 42. And it is FREE. *Send your name. Today is best.*

SOUTHERN CYPRESS MFRS' ASSN.

1249 Perdido Building, New Orleans, La., or
1249 Heard Nat'l Bank Bldg., Jacksonville, Fla.

2

Popular Science Monthly

FEB., 1921

Volume 98-No. 2

Important to Readers

Owing to the paper shortage, the number of printed copies of POPULAR SCIENCE MONTHLY is limited. To insure getting your magazine regularly, you should place a standing order with your newsdealer, or send us your yearly subscription of $3.00.

CONTENTS

AERONAUTICS

The Wind-Tunnel at St. Cyr	24
Stronger Airplane Propellers	26
New Wings for the Airplane	29
A Wild Air Ride Through Omaha	36
Landmarks for the Aviator	37
To Jail by Airplane	43
How We Look from Above	55
Planes that Went to Alaska	58
In a Glass Case for Six Days	65
The Smallest One-Man Airplane	71

HOUSEKEEPING MADE EASY

A Japanese Hat for a Lamp-Shade	43
A Quarter's Worth of Electricity	43
Typewriter Lamp Made from Speedometer Shaft	55
Saving Coal with a Flower-Pot	55
An Electric Decorative Table Fountain	56
Daffodils Make Pretty Candlesticks	56
A Concrete Garbage-Furnace	57
Fish-Nets for Active Babies	58
Use Old Automobile Cushions	58
Scrubbing Floors Electrically	62
Hooks to Hang Pictures Straight	66
It Will Keep Doors from Banging	66
The Old Horn as a Funnel	70
It's Tea-Ball and Teapot Too	71
Push the Bed into the Wall	83

INDUSTRIAL PROGRESS

Cameras and Divers to Restore Coal-Mines	23
An Electric Sawmill on Wheels	26
Edison Talks on Super-Labor-Saving Machines	31
A Paper Suit for One Dollar	33
This Big Pipe Regulates the Flow	34
Electric Lights in the Desert	36
Making Use of the Smoke of Walnut Shells	36
Bracing the Riveter	38
It Blows Wherever It Goes	38

(*Continued on page 4*)

Copyright, 1921, by the Modern Publishing Company

POPULAR SCIENCE MONTHLY is issued monthly. Yearly subscription in the United States, $3.00. Canada, $3.50. Foreign, $4.00. Single copy, 25 cents.

Advertising rates on application. Forms close the twentieth of the second month preceding date of publication. Entered as second-class matter Dec. 28, 1915, at the Post Office at New York under the act of March 3, 1879. Entered as second-class matter at the Post Office Department, Canada.

The contents of this magazine are copyrighted and must not be reprinted without permission.

H. J. Fisher, President; R. C. Wilson, Vice-President; O. B. Capen, Secretary and Treasurer.

Modern Publishing Company
225 West Thirty-ninth St. New York City